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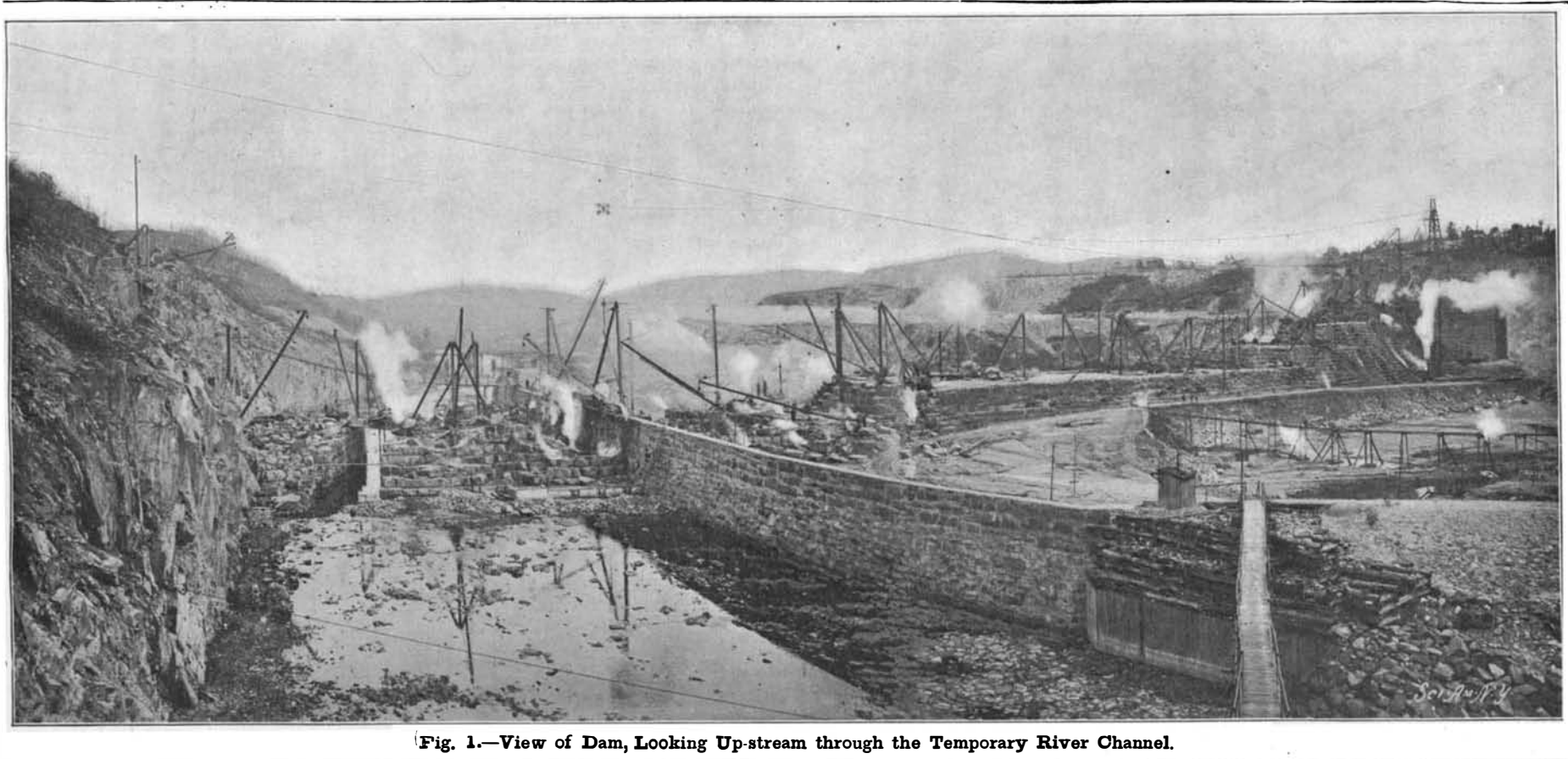


Fig. 1.—View of Dam, Looking Up-stream through the Temporary River Channel.

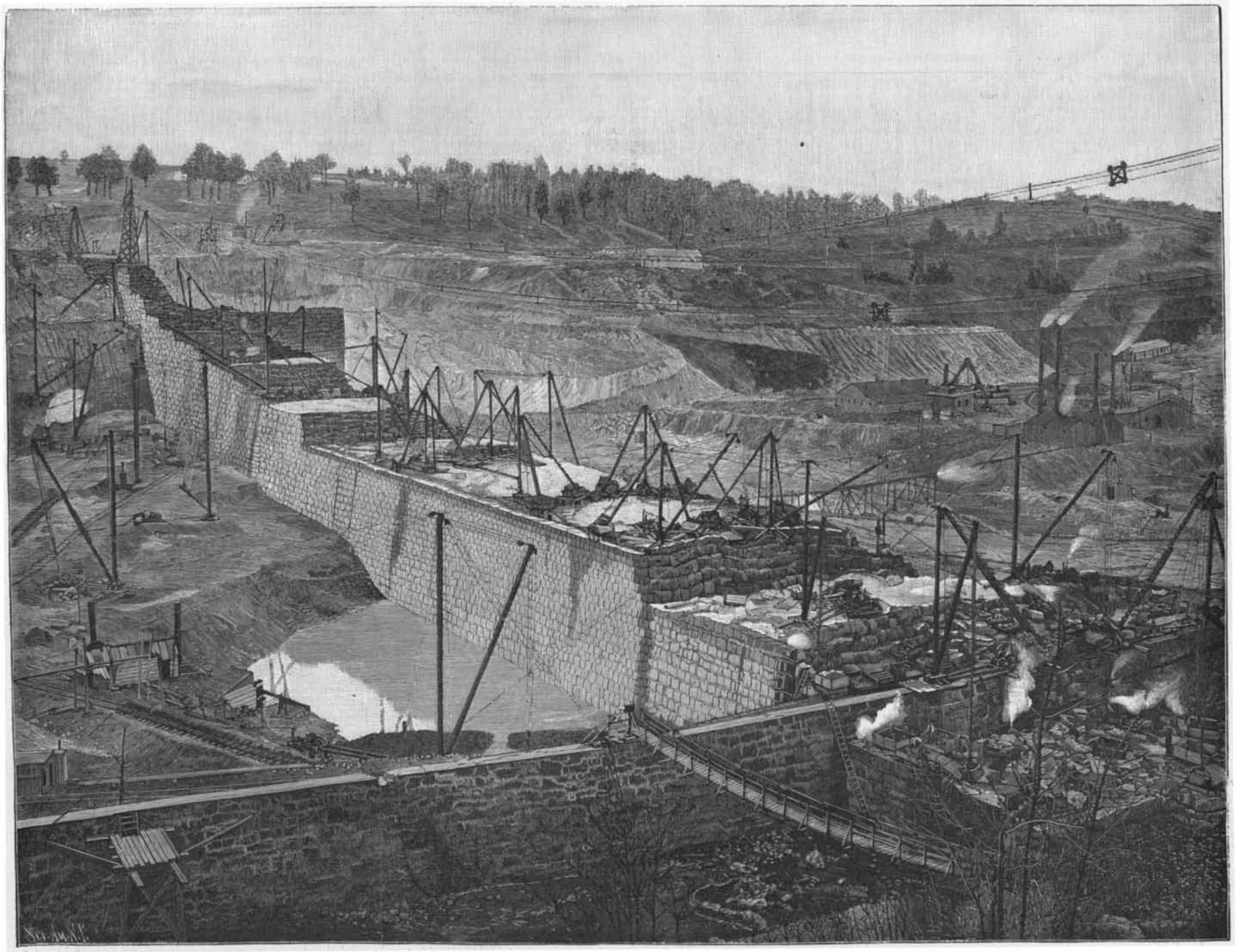
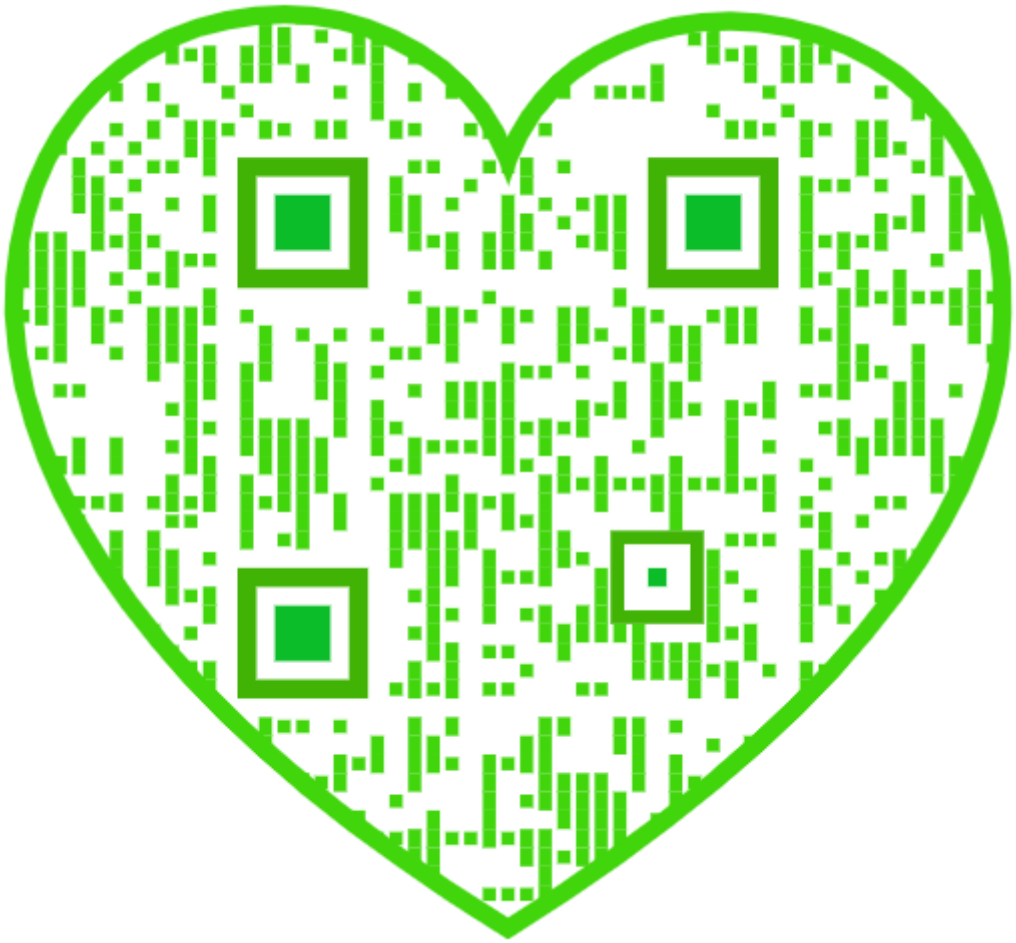


Fig. 2.—Up-stream Face of Dam; Bed of Reservoir will be at Present Level of Masonry at Center of Dam.

THE GREAT CROTON DAM—NEW YORK CITY'S WATER SUPPLY.—[See page 86.]



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LEGISLATIVE FOOLISHNESS.

More often than not, when our legislators undertake to improve the patent laws, they lend themselves to proposals which are grotesque in theory, and if they ever became law, would be impossible of practical application. Members whose legislative proposals are ordinarily, if not invariably, marked by good judgment and clear-headed common sense, have a way of committing themselves to the most crude absurdities when they introduce bills for the improvement (Heaven save the mark!) of the statutes which govern that most successful institution known as the United States Patent Office.

Why the amendment of patent laws should beget such an annual crop of foolishness is quite beyond our ken; it is a curious phenomenon which we commend to the X-ray insight of the psychological expert.

We have before us the draft of two bills, one, No. 269, introduced in the Senate, and the other, No. 2941, in the House, that betray the usual ignorance of the true purpose of our patent laws, which is, we take it, to keep alive and promote the spirit of invention by securing to the inventor his just and proper rewards. One of these bills, as we shall see, would rob the inventor of his profits altogether; and the other would make the realization of his profits so precarious as to discourage ninety-nine men out of a hundred from making any application for a patent whatever.

The Senate bill contains the following: "No patent shall be granted . . . . upon any device adapted to be used in the treatment of human disease or disability, or attached to the human body and used as a substitute for any lost part thereof, ... unless such device is adapted to be put on the market and sold substantially complete and ready for use or attachment." Now, while we are willing to admit that the framer of this bill may have been actuated by the best of motives, as a matter of fact, it would, if passed, defeat the very object at which it aims. We are well aware that there is a widely extended prejudice against the medical profession taking out patents upon special medicines, or upon mechanical appliances to assist the crippled or injured, and we fully appreciate the professional spirit which begets this prejudice. But as a matter of fact the production of artificial limbs, belts, trusses, and various aids of the kind, is not confined to the profession; the larger proportion of these devices being invented by laymen, or by firms who make a specialty of their manufacture. The invention of artificial limbs and surgical appliances is of a strictly mechanical nature; and the pecuniary reward which the Patent Office enables the inventors to reap is a powerful incentive which, as the result shows, assists greatly in mitigating the sufferings of the crippled and infirm. To deny patent protection would undoubtedly discourage invention and reduce the number of workers in this important field. The motives which prompt the bill may be praiseworthy; but the practical effect would be decidedly harmful, and certainly the very reverse of that intended.

Even worse in principle is the proposal contained in the last clause of the bill, to the effect that "no suit or action shall be maintained for the infringement of any patent, unless it appears that such device can be made and put upon the market substantially complete and ready for use or attachment." The purpose of this amendment is plainly retroactive, and its effect would be to rob thousands of citizens of property rights which have been deliberately granted to them under the law. Holders of patents, assignees, and purchasers of royalties, who have paid large sums for privileges conferred under the existing statutes, would find their holdings, upon the passage of such an amendment, worth not even the paper upon which they were written. This bill, if it ever emerged from the committee and should by accident receive the sanction of Congress, would be manifestly unconstitutional.

Bad as is the Senate bill, that introduced in the House is worse; for while the former reduces the number of inventions which may be patented, the latter jeopardizes the commercial value of every patent that may be granted. If the introducer of this bill has his way, the present practice and methods in the securing and handling of patents will be turned completely upside down—as witness the following comprehensive and brilliantly original provisions: 1. The inventor when applying for a patent must file with the Commissioner a sworn statement of his estimate of the cost of manufacturing his article, machine, device, etc. 2. The Commissioner from this estimate will fix the amount of royalty to be paid on each article, machine, etc. 3. This royalty must be not less than 1 or more than 10 per cent of such estimated cost of manufacture. 4. Any person or corporation shall, upon payment of this royalty, have the right to use, manufacture and sell the article, etc., so patented, provided he or they attach to the article a stamp or certificate certifying that the royalty has been paid. 5. The United States government reserves the right to condemn such patents for its own use.

We ask: 1. How can the patentee estimate the cost of manufacturing an article which exists as yet only upon paper, and will be the subject of many successive patents before it reaches its perfected form. Even if the distracted man should hazard a guess, unforeseen difficulties of manufacture may arise that will make the cost ten times greater than he thought. 2. By what God-given fore-knowledge is the Commissioner to determine the extent of these risks, and so fix an equitable royalty? 3. Why should the royalty never be less than one—why should it never exceed 10 per cent of the cost? 4. From time immemorial men have been wont to sell their goods or not sell them as they liked. From what new system of ethics has the framer of this bill learned that this time-honored prerogative is vicious and calls for correction? 5. Why should the United States government be empowered to take away with the left hand what it has given with the right?

It is refreshing to turn from such legislative trifling to Senator Hansbrough's really excellent bill, No. 1,883, to establish "a high court of patents, trade marks, and copyrights, which shall consist of one chief justice and of six associate justices, to be appointed by the President of the United States, by and with the assent of the Senate, and which shall be a court of record with appellate jurisdiction." If this admirable bill, to which we shall refer at some length in a later issue, become law, all appeals by writ of error or otherwise from district courts shall not be taken to existing circuit courts, but shall be subject to review only in the Supreme Court of the United States or in the high court of patents, trade marks, and copyrights as thus established.

OFFICIAL TRIAL OF THE UNITED STATES CRUISER "ALBANY."

Special interest attaches to the reports of the official trial of the "Albany" which have just come to hand, for this vessel is a sister ship to the "New Orleans," which has been the subject of a large amount of unjust official criticism since her arrival in this country. It has been freely charged by our Construction Department that the "New Orleans" is a "show vessel" built by the Armstrong Company "to sell;" that her stability is seriously in question; that she has poor seagoing qualities; and that she is unable to come within several knots of her reputed speed. The "New Orleans" and the "Albany" were purchased during the recent war from the Brazilian government, for whom they were being constructed by the Armstrong Company. The "New Orleans" was delivered immediately, and the "Albany," after some slight modifications of her interior arrangements, was completed with all possible dispatch. The ships are sister vessels and practically identical in every respect.

When the most extraordinary charges of our Construction Department against the stability of the "New Orleans" were made known to Armstrong & Company, extensive stability tests were at once made of the "Albany," which showed she is not only a thoroughly stable vessel, but actually has a larger margin of stability than certain vessels already in our navy; and as for her speed, the recent trials, which were carried out under the supervision of a United States Naval Board consisting of Lieutenant Commander Colwell, Chief Engineer Norton, and Naval Constructor Gilmore, showed that the "Albany" is capable of a speed in excess of the contract requirements, and that she is thoroughly seaworthy. On the four trials over a measured mile a mean speed was recorded under natural draught of 19·6 knots, or 0 6 knot above the contract. Under forced draught her mean speed was 20·5 knots, with a maximum speed of 20·87 knots, her contract speed under these conditions being 20 knots. Lieutenant-Commander Colwell expressed himself as greatly pleased with the ship, stating that she came fully up to all requirements. A day or two later the vessel was sent out for her endurance trials, which consisted of a continuous run of 6 hours under natural draught. The ship behaved well in a heavy sea, and the results were as follows: Speed per hour, 19·3 knots; horse power, 5624; and consumption of coal per 24 hours, 144 tons.

These trials are a case of "a fair field and no favor," and that such excellent results, especially in the natural draught endurance trials, should have been recorded, will settle, we trust, for good the question of the speed of these splendid vessels.

Although the results of these speed trials are highly gratifying, they are not phenomenal. In every navy of the world except our own similar speeds are being aimed at and achieved in vessels of this class. In the United States navy, unfortunately, we have gone back a decade and a half in the matter of cruiser speed, the contracts having just been let for the construction of six cruisers of the "Albany" type whose maximum speed is to be only 16½ knots.

The only reason that the gentlemen who are responsible for the design of these ships have given for knocking off 4 knots from the speed, is that two high-powered 20-knot cruisers that they designed ("Raleigh" and "Cincinnati") were failures; to which the obvious reply is that if our failures are to determine the standard of our future efforts, the outlook is decidedly discouraging.

To argue that because the "Raleigh" and "Cincinnati" failed to maintain their designed speed in actual service, therefore the contract speed of future cruisers must be reduced, is a confession of failure which is at strange variance with the traditions of a navy, which in the originality and progressive spirit of its work has been accustomed to lead rather than to follow.

THE ISTHMIAN CANAL.

The problem of constructing a canal across the Isthmus of Panama grows more interesting and certainly more complicated as the days go by. The latest development is that the American attorneys of the French Panama Company state that a company has been formed of several of the leading financiers of this country for the purpose of going ahead and completing the canal at Panama with private capital. It is stated that $100,000,000 bonds will be issued and that the corporation will increase its capital to $120,000,000 in order to complete the work. On the other hand, we have the Eyre-Cragin concession, which was obtained about twelve months ago from the Nicaraguan government, for the construction of the Nicaragua Canal. This concession was obtained on behalf of a New York syndicate, which declares that it has the ability and willingness to go ahead and construct a canal with its own capital. Meanwhile the Maritime Canal Company, of Nicaragua, which has done a considerable amount of surveying, and an inconsiderable amount of construction along the Nicaragua route, is endeavoring to enlist government influence in securing a renewal from Nicaragua of its concession, which has lapsed owing to the Company's failure to complete a canal within the specified time.

A fourth influence which is at work is represented by certain of our legislators, who will again attempt to crowd through Congress some measure authorizing the government to build the Nicaragua Canal and to set about it at once, regardless of the advantages or prospects of any other scheme for canal building, either at Nicaragua, Panama or elsewhere. Mr. Hepburn is again at work upon a bill of this character—and this, moreover, in spite of the fact that the President's own commission, which was sent out at a cost of a million dollars to find out the real truth about the situation, and determine on the best location of the canal, has not yet reported.

It seems to us, and it must be evident to every person who uses a little sober judgment on the question, that the obvious course of the government is to await the report of its own commission before taking any steps whatever in the matter. If the American Panama Canal Company is able and willing to take hold of that unfortunate enterprise and push it to completion, well and good. We can conceive of no better solution of the problem.

AMERICAN GOODS IN RUSSIA.

American goods and specially American manufactured articles are making rapid gains in popularity in Russia. This is shown by the increased total of our exports to that country, and also by the warnings which the consular representatives of other nations in Russia are sending to their home governments respecting the popularity of American goods and the success of American merchants in their business methods. The British consul at Kieff reports that while Germany is talked about as Great Britain's greatest rival in the markets of the world, there does not seem to be the same attention paid to the rapidly developing competition of America, and gives many instances, citing the agricultural machinery trade, which is practically controlled by Americans; also steam pumps and machine tools. The British consul at Odessa says that bicycles of English make are held in high esteem, but they are distanced by American machines, as they are supplied 40 per cent cheaper than those of the English make, and consequently undersell them. In 1893 exports from the United States to Russia amounted to $2,447,414, according to the reports of the Treasury Bureau of Statistics, and in 1899 the value of the exports was $10,023,783.

BRITISH AND BOER GUNS—A LESSON FROM THE SOUTH AFRICAN WAR.

BY LIEUT. GODFREY L. CARDEN, R.C.S.

There is a lesson to be learned from the war in South Africa which can well be taken home by every nation not supplied with field artillery the equal of the best. England, despite her great gun shops and enormous resources, has found herself outclassed from the start by the field-gun equipment of the Boers. The results, so far, have been checks, reverses, and defeats.

The superiority of the Boer field artillery over the English field-guns is not surprising, when it is known that the forces of the Transvaal are provided with Creusot and Krupp pieces. The only wonder is that England has been content to possess artillery weapons known to be inferior to the best guns on the Continent. We use the term "known" advisedly, since attention to this very fact has been called by prominent artillerists during the past two years. Reports from Gen. White's forces state that the effective range for his field-guns did not exceed 4,000 yards. If Gen. White is provided with the standard 3-inch Woolwich field-gun, which we understand is the case, the only surmise is that the range referred to shrapnel. For shell proper the Woolwich gun claims a range of 6,500 yards.

From late reports it is announced that a large number of the Boer field-guns consist of Creusot 14-pounder pieces of 2·96 caliber, employing muzzle velocities of 1,837 foot-seconds. The range claimed for these weapons is 8,744 yards. A peculiar feature of the 14-pounder is its narrowness of carriage track—3·56 feet—as compared with the standard 5 foot 2 inch gage English field carriage. The shrapnel shell of the 14-pounder contains 234 bullets. There is sufficient remaining velocity, it is asserted, at 4,500 yards to enable this French shrapnel to do effective work.

Within the past ten days the dispatches have stated that the British authorities, recognizing the inferiority of the Woolwich-made field-pieces, have placed an order for one hundred Vickers 12-pounder guns of the rapid-fire type. The Vickers weapon is said to be one of the most effective guns turned out to-day in England. It is a comparatively new piece, and this order of the British government is practically the first recognition it has received at English hands. Quite recently several mountain guns of the Vickers variety were purchased by the United States government for use in the Philippines. When we consider that the British forces at Ladysmith were only saved from early destruction or capture by the arrival of the naval 4·7-inch guns from Durban, the importance of range is brought home with marked emphasis. These naval guns were mounted on the rudest kind of structures, and happily the mounts held. Rapidity of fire and mobility were in this instance sacrificed for range and with the result that the Boer fire was dominated.

In view of the lessons of the South African war, the progress of the ordnance authorities of this country in developing a rapid-fire field-gun will be watched, naturally, with keen interest. Experimental guns have been designed, it is learned, at the Watervliet arsenal, and comparative tests are to be made between these government pieces and special guns designed by the Driggs-Seabury Company and the American Ordnance Company. The gun submitted by the Driggs-Seabury Company has a caliber of 3 inches (the proposed standard caliber for this country) and a muzzle velocity of 1,800 foot-seconds. The carriage is remarkably light and simple, and both the gun and carriage weigh less, respectively, than the service piece and carriage now in use.

The present field-piece of the United States has a caliber of 3·2 inches. It was introduced into the service about seventeen years ago. It is this gun which it is proposed to replace by a weapon of 3-inch caliber, having a muzzle velocity of about 1,725 foot-seconds and using a shell weighing 15 pounds. Two years ago the Chief of Ordnance, in his report, indicated that a muzzle velocity of 1,600 feet per second would suffice, since this velocity would afford effective shrapnel results at 3,500 yards. Now it is proposed to obtain 1,725 foot-seconds, and it is gratifying to note that one of the competitors considers it practicable to use 1,800 foot-seconds at the muzzle under ordinary service conditions. When one considers that field artillery in the United States is apt to encounter country roads incomparably worse than in Europe, there is some excuse for making carriages stronger and heavier. There has been doubt expressed by many artillerists of the ability of the high-velocity Creusot carriages to stand rough service, and it will be interesting to learn how far these forebodings have been borne out. So far no complaint has been heard from the Boer side.

Up to the present time the Canet 2·95-inch, L-32, gun, and the Creusot 14-pounder 2·96-inch weapon, are recording the highest velocities among the Continental pieces. Both guns, it will be observed, are using lighter shells than the proposed new American piece. It must not be overlooked that a gun that can deliver 1,800 foot-seconds velocity to a 15-pound shell is a powerful weapon. Compare this gun with the English Woolwich-made piece, and we find the English 15-pounder employing only 1,600 foot-seconds and mounted on a carriage unsupplied with recoil-checking device. Even the Vickers gun, splendid weapon as it is, secures its 1,720 foot-seconds velocity with a shell weighing three pounds less. Of the two projectiles, the 15-pounder, by reason of its greater shrapnel-carrying capacity, to say nothing of energy, is the superior.

But granting that the new guns of this country will yield 1,800 foot-seconds velocity, and this is slightly more than the authorities are indicating, the question arises: Will even that velocity assure our batteries a superiority over foreign field-guns in time of battle? Shrapnel balls, in order to inflict dangerous wounds upon horses, must possess an energy of about 282 foot-pounds. This requires, for bullets weighing forty-two to the pound, a remaining velocity of 874 foot-seconds. A muzzle velocity of 1,600 foot-seconds for a 15-pound shell yields 874 foot-seconds remaining velocity at 3,500 yards.

The shrapnel shells of guns in the hands of the Boers have been found fused for 5,200 yards. The English field-gun shrapnel is fused for 4,000 yards. Boer shrapnel, possibly from guns of the siege variety, though there is no definite information on this point, has been found effective at 5,100 yards; in other words, at a range of 1,100 yards beyond the possibilities of English field-guns. Not only have the British pieces been found weak in range, but they have proved altogether too heavy both in gun and carriage. The British reports from the front summarize the needs in the demand for a gun that will shoot accurately and deliver shrapnel effectively at 5,000 yards. This will probably involve a reduction in shell weight, but judging from the guns in the hands of the Boers, it should not mean a loss of mobility.

The whole question is a most important one, and now that the United States is on the eve of adopting a new gun, the lessons from South Africa have especial value. The inventive resources of this country, and the well-known mechanical skill of its people, should make it possible to evolve a weapon the superior of any abroad. We have developed naval guns and seacoast weapons and carriages of remarkable strength and power, but the rapid-fire field gun of high power is lacking. There is every reason to believe, however, that this condition will not long exist.

PALISADE PRESERVATION.

The two Commissions—the New Jersey and the New York Commission—which have been investigating the question of preserving the Palisade cliffs from further devastation, have presented their reports after six months' work. The Commissions have held joint and separate sessions. The New Jersey Commission's report says that the natural beauty of the Palisades has been marred and is threatened with further spoliation in two ways, first, by the blasting away of the cliffs to procure stone for street and road-making purposes, and, second, by the occupation of the river shore by unsightly business structures. The ease with which the cliffs can be quarried and the stone removed by water makes the Palisades a peculiarly attractive field for the quarryman. Some of the quarries are now running day and night to supply the demand for their output, and there is every reason to believe that in the course of time the section above Fort Lee will become as badly mutilated and as completely destroyed as the old section has already been.

In the way of preservative measures, both the New Jersey and the New York Commissions make the following recommendations: First, that the plateau above the edge of the cliffs may be eliminated from the discussion because of the large expense which its purchase would entail. It is deemed desirable to give authority to purchase such parts of the upper plateau as shall be deemed advisable by a permanent Palisade Park Commission, in order to give the public access to the cliffs and to enable them to enjoy the view therefrom. At present there exists no corporate body having any authority to hold for public use any parcel of Palisade real estate which might come into its possession by purchase, gift or bequest. The first action to be taken in the matter should be the passage of an act by the Legislature constituting the permanent commission already referred to, with power to acquire and hold for the State as much of the land between the edge of the cliffs and low-water mark as may be deemed necessary to prevent further destruction of the Palisades. The land so acquired would constitute a park through which might run a boulevard. A bill providing for such a commission is in course of preparation and will be submitted to the Legislature. The commissions also advise the passage of an act forbidding the granting of any further riparian rights along the strip to be protected.

THE "KAISER WILHELM" AGAIN BREAKS HER RECORD.

The "Kaiser Wilhelm der Grosse," of the North-German Lloyd line, added another record to her many brilliant passages. She reached Cherbourg on her last trip after covering 3,077 knots in five days and sixteen hours—an average speed per hour of 22·63 knots. It would seem from this as though the great "Deutschland," which is nearing completion for the Hamburg-American line, will have to utilize all of her 35,000 horse power to obtain the coveted blue ribbon of the Atlantic.

MAGNETISM OF THE EARTH.

H. A. Rowland, Professor of Physics at the Johns Hopkins University, has just announced a remarkable discovery of great importance, being no less than an explanation of the cause of the magnetism of the earth. Dr. Rowland commenced his experiments nearly a year ago. The subject attracted him, owing to the lack of explanation of the theory of the earth's magnetism. His experiments will soon be reported fully. The apparatus used consists of a simple metal wheel revolved upon a shaft by means of an electric motor. The wheel itself is wound with several miles of fine wire, and in this magnetism is developed when the wheel is revolved. About the wheel is a casing of brass about a half inch from its circumference, leaving a space between which may be said to represent artificially the layer of atmosphere about the earth. Dr. Rowland is now working to show that the faster the revolution of the wheel, the greater will be the magnetism developed. He has already shown that magnetism is produced in this revolving body; and although upon such an infinitesimal scale in the laboratory experiments, Dr. Rowland is convinced that the principle holds good for the earth and other bodies as they revolve through space. The immense weight and great speed with which these bodies rotate add to the amount of magnetism which they produce. It will take a long series of delicate experiments to bring out the various phases of the relation of magnetism to the speed of the revolving bodies. The results which have been obtained so far have been so satisfactory that work will be continued on this line.

TORPEDO BOAT MAKES OVER 35 KNOTS AN HOUR.

The "Viper" has recently passed through her official trials with very creditable results. In four consecutive runs over a measured mile she attained a mean speed of 34·8 knots an hour, the fastest mile being covered at the rate of 35·5 knots. The maximum speed, therefore, was equal to just 41 miles an hour. On her preliminary trial the "Viper," when indicating about 7,500 horse power, ran at the speed of 32 knots an hour. It is said that on her recent full-power trial she indicated between 10,000 and 11,000 horse power. This vessel, as our readers are aware, is an enlarged "Turbinia," her length being 210 feet, beam 21 feet, draft 7 feet, and displacement 325 tons. The record speed for any vessel was originally held by the "Turbinia," which was also propelled by a turbo-motor. Subsequently the torpedo boat "Hai Lung," built by Schichau for the Chinese navy, a boat driven by reciprocating engines, was reported to have made 35 knots an hour, which was within half a knot of the present record. It is claimed, however, that the "Viper" will be subsequently improved so as to add another knot or more to her speed.

A REMARKABLE COLLECTION OF LAMPS.

At the National Museum, in Washington, there is a most interesting exhibition of lamps brought together under the direction of Mr. Walter Hough, who is an expert on the subject and whose writings on the light and fire of Eskimos are most interesting. The lamps are of all ages from the time of the Pompeian and Roman lamps up to the present day. Some of the lamps are of great interest, as, for instance, the firefly lamp from the West Indies. The lamp is about 18 inches high and built in three stories, made of wicker and bamboo cages with little doors. The fireflies are imprisoned in this and cared for and fed. The Japanese lanterns suspended from sticks are of many types. Among the Chinese lamps are those made of bamboo which are used to light alleyways. They are a frequent cause of conflagration. Old English horn lanterns, or "lanthorns" as we ought to call them, would delight the heart of the collector of curios. There are also olive oil lamps, Eskimo lamps, etc. The collection is worthy of considerable study.

A WARNING TO THE INVENTOR.

Intending exhibitors at the Paris Exposition will do well to protect their inventions by means of foreign patents before sending their devices, for international expositions have always offered a splendid opportunity for unscrupulous imitators of new devices and inventions to pirate them if they are not covered by foreign patents. It is also believed that trademarks will be infringed in the future as in the past. The Parisian "Inventors' Academy" is also attempting to do an unusually large business, and there are so many pitfalls arranged for the inventor that it would be well before making contracts of any kind to make sure of the standing, financial and otherwise, of the firms which are to attend to American exhibits. The United States Commission will undoubtedly be glad to give information on this point and to protect intending exhibitors in all possible ways.

THE NEW CROTON DAM—NEW YORK CITY'S WATER SUPPLY.

New York city is favored with a water supply which is not only plentiful, but is of an exceptionally good quality. The Croton watershed, from which it is drawn, is located from 30 to 40 miles north of the city, and has a catchment area of 362 miles and an average yearly rainfall of 46 inches, the average yearly flow being 135,400,000,000 gallons. The Croton reservoir, from which the present water supply of the city is conveyed by two aqueducts is located about six miles from the mouth of the Croton River, which empties into the Hudson. It was constructed about fifty years ago and has a capacity of 1,000,000,000 gallons. The Croton reservoir was built about half a century ago; subsequent to its completion several others of various capacities have been built further back in the higher levels of the Croton watershed.

Although the Croton works sufficed for the population of 350,000 which New York contained at the time they were built, they have long since grown inadequate to the needs of the present population. The new Croton dam, which is being built across the valley at a point 3¼ miles below the old dam, is part of a great scheme for increasing the total capacity of New York city's water supply to 75,000,000,000 gallons. In some respects the new dam will be the most monumental work of its kind, for while there are dams that are longer on the crest and that impound a greater amount of water, there is none that equals this in its enormous height and the great area of its cross-section.

The dam will consist of three portions. The first 400 feet on the south side of the valley will be an earth dam, with an interior masonry core wall. The commencement of this core wall is shown at the extreme left of the dam in our illustration, Fig. 2. It reaches from the hillside to a massive wing-wall which extends down stream at right angles to the axis of the dam. This wall will also be noticed in the same engraving. Next to the core wall portion is the masonry dam, which is 650 feet in length and extends to within 200 feet on the north side of the valley, where it bends sharply back to the right and runs up the valley, parallel to the contours of the hillside, for a distance of 1,000 feet, finally turning in to a junction with the hillside. This last 1,000 feet is the spillway, and on account of its great length and width it will be amply able to take care of any flood that comes down into the lake, even should the flood be caused by the bursting of one or more of the upper reservoirs.

In Fig. 3 we show a cross-section through the masonry dam at its deepest point. In order to find a satisfactory foundation, it was necessary to excavate a huge trench across the valley, removing all of the sand, gravel and hardpan until solid and compact foundation rock was laid bare. This necessitated digging the trench to a maximum depth at the center of 131 feet below the original bed of the river. The vast amount of material thus removed was carried by cars and dumped above and below the dam in the embankments which will be noticed in our engravings. The width of the trench at the bottom was over 216 feet, this being the greatest breadth of the masonry foundation. The work of excavating was commenced in 1892 and completed in 1896. During this period it was necessary to remove 1,100,000 cubic yards of material. The appearance of this great excavation when only partially completed in shown in Fig. 4. Another important preliminary work was that of providing a temporary channel to convey the Croton River around the dam during the progress of the work. This channel, which is a conspicuous feature in our first illustration, was formed by constructing across the axis of the dam 600 feet of wall, 20 feet high, with two wing dams at each end of the wall, the width of the channel thus formed being 125 feet measured from the toe of the hill.

The cross section of the dam (Fig. 3) shows the up-stream face to be approximately vertical, while the other face slopes up stream at an angle of about 45°, rounding up into the perpendicular at the coping. The bulk of the masonry will lie out of sight below the bed of the river, the depth from the bed of the river to the lowest course of masonry being 131 feet. As fast as the masonry was built up in the trench, the excavated material was brought back in cars and dumped in the trench. The new bed of the reservoir as thus filled in will be about 134 feet above the foundation, while the water level of the dam when full will be 160 feet above the new bed; the total height of the masonry from foundation to crest will therefore be about 300 feet. The masonry has now been completed to slightly above the level of the new bed, the amount of rubble masonry already laid being about 475,000 cubic yards out of a total amount in the completed dam of 650,000 yards. From the bed of the reservoir to the crest of the dam the masonry will be faced with a very handsome, light-colored granite, which will have the appearance of marble, and with the parapet and ornamental finish which it is intended to give the crest, the finished structure will have an exceedingly handsome and imposing appearance.

The illustration, Fig. 1, shows that portion of the dam which intersects the temporary river channel. The retaining wall of the channel will not be removed, but is now being incorporated and built into the permanent masonry. A narrow channel is being left for the passage of water, and this will serve for drainage until the large blow-off gate-house which is to be erected at this point has been built. The latter will contain three 48 inch pipes, and through these the reservoir water will flow during the construction of the dam. After its completion they will be used for emptying the reservoir whenever it is desired to inspect it.

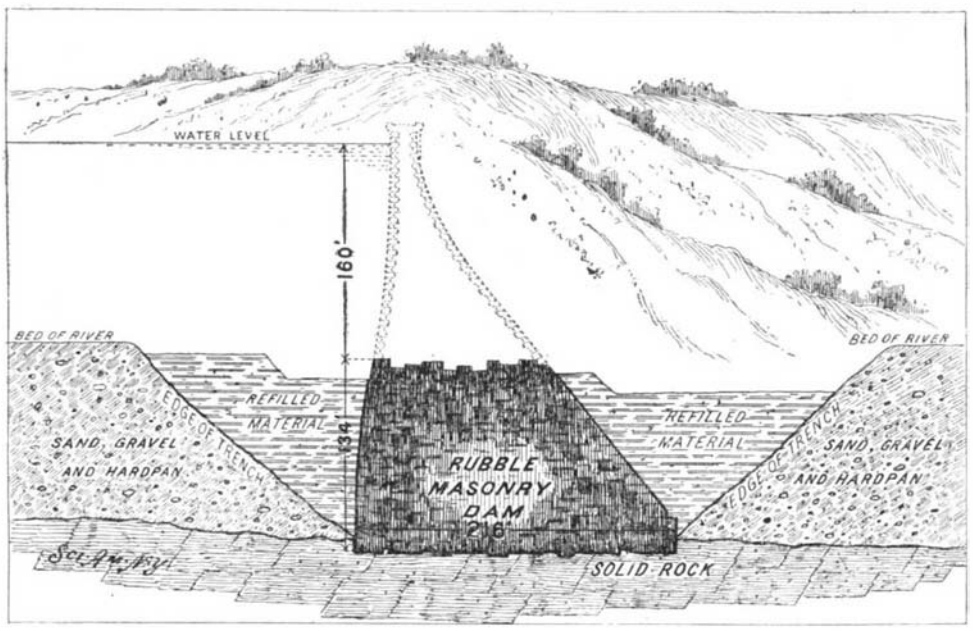


Fig 3.—Section Through Croton Dam, Showing the Excavation, Completed Masonry, and Refilled Material.

The present series of illustrations show that this great engineering work is within measurable distance of completion, and it will probably be opened in the year 1902. As soon as everything is ready, the blow-off gates will be shut and the dam will be allowed to fill. As it does so, a great change will take place in the appearance of this picturesque valley, which will ultimately be filled with a vast sheet of water that will back up as far as the well-known Croton Falls, fifteen miles up the river. As the crest of the new dam is 30 feet higher than the crest of the old Croton dam, 3¼ miles up stream, the latter will disappear from view entirely, being buried 30 feet below the surface of a beautiful lake eight square miles in extent, which will henceforth form not the least attractive feature of this most attractive country.

The whole work is being carried out by Messrs. Coleman, Breuchaud & Coleman, under the immediate direction of Divisional Engineer C. S. Gowan.

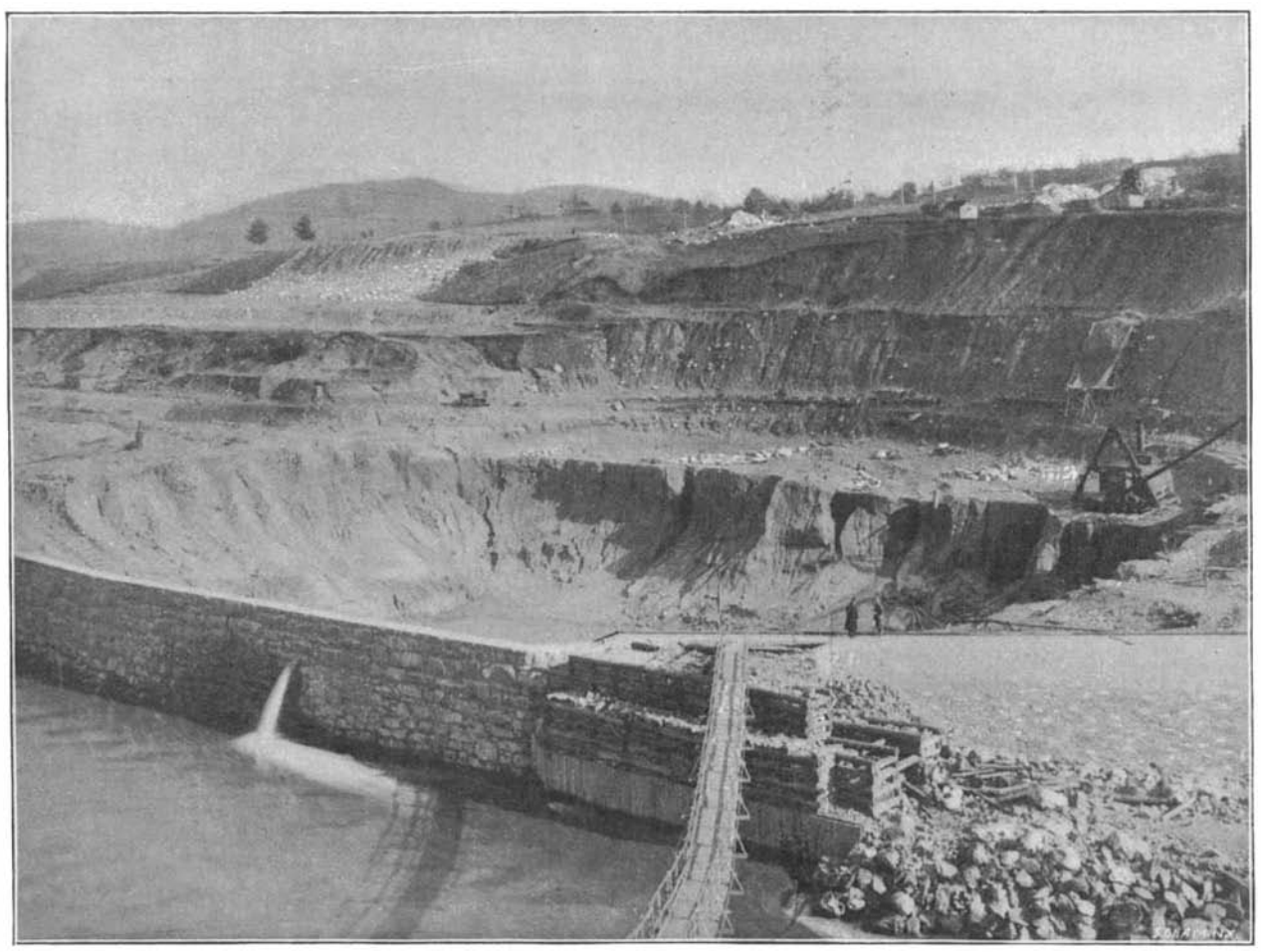


Fig. 4.—Excavation, 130 Feet Deep, for the Dam Foundation.

THE NEW CROTON DAM—NEW YORK CITY WATER SUPPLY.

Heat Radiation of the Stars.

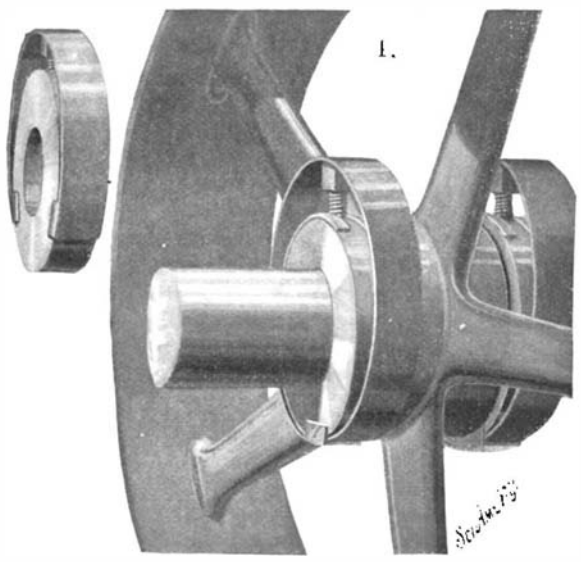
The author commences by reviewing the negative results of C. V. Boys, who used in connection with a 16-inch reflecting telescope a radio-micrometer sensitive enough to show the heat equivalent to that of a candle 1·71 miles away. E. F. Nichols, of Dartmouth College, has spent much time in perfecting the radiometer, and the present form of the instrument is for certain purposes considered superior to either the radio-micrometer, bolometer, or thermopile. In July, 1898, Nichols was invited to test his instrument at the Yerkes Observatory, and the apparatus was installed in the heliostat room, where the stability was so perfect that deflections to tenths of a millimeter could be observed. The radiometer used consisted of a suspension system formed of two mica disks, each 2 mm. in diameter, blackened on one face, and supported by a light cross arm on either side of a thin glass staff, hung by an exceedingly fine quartz fiber in a partial vacuum. Both vanes were exposed to the radiation of the sky at the focus of a silvered glass mirror of 24 inches aperture, fed with light by a siderostat outside. The rays entered the radiometer through a small window made of fluorite. With the apparatus so arranged a deflection of 0·1 mm. would be given by a candle fifteen miles distant, neglecting loss by reflection and atmospheric absorption. Seven determinations of the heat radiation of Arcturus gave a mean deflection of 0·60 mm. Vega gave a mean deflection of 0·27 mm. Although the quantitative value of these results is not insisted upon, the author considers that they show the reality of the detection of stellar heat radiation.—G. E. Hale, Astro. Phys. Jour.

THE widow of the great physicist Hermann von Helmholtz is dead. Her salon at Heidelberg and in Berlin was the great center of those interested in German science and art, and the late Emperor and Empress Frederick were frequent visitors there.

A GUARD FOR THE PROJECTING PARTS OF MACHINERY.

To provide a protector for set-screws and other projecting parts on revolving collars, shafts, pulleys, chucks, and the like, is the purpose of an invention which has been patented by Joseph A. Clercy, 221 W. 123d street, Manhattan, New York city. Fig. 1 shows the guard applied to a collar adjacent to a loose pulley. Fig. 2 represents a simpler, modified form of the device.

The guard comprises essentially a spring-band coiled about and extending over the head of the projecting part, which in the illustration is a set-screw securing a



A GUARD FOR THE PROTECTION OF PROJECTING MACHINE-PARTS.

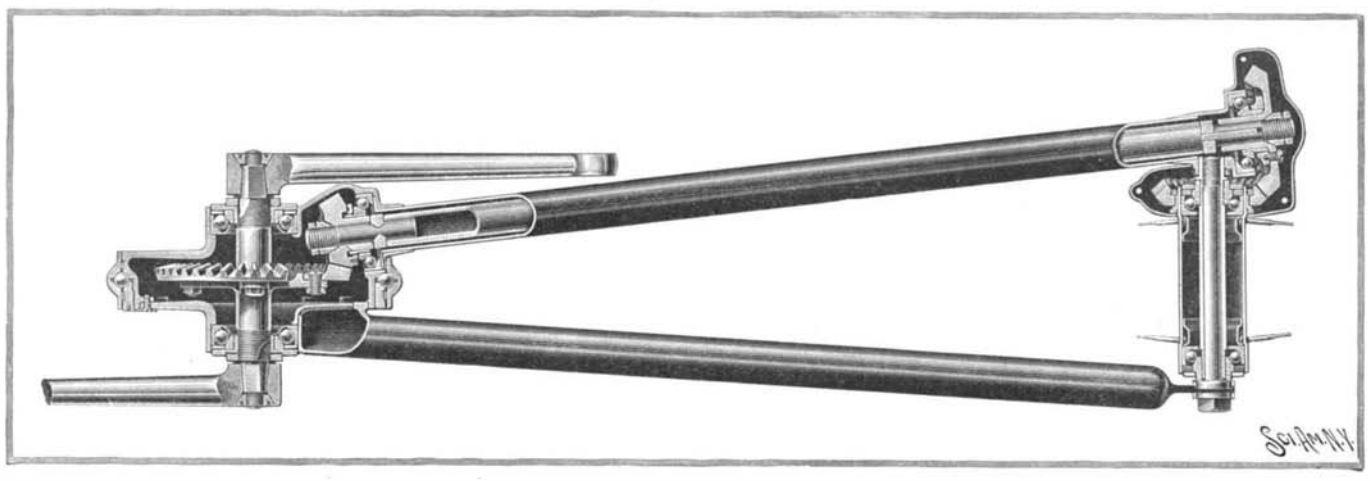
collar adjacent to a pulley on a revolving shaft. The end of the band is formed with a long slot which receives the screw to prevent the displacement of the band. The ends of the band overlap. And the overlapping end of the band is provided with lugs which straddle the side faces of the collar and the sides of the other end of the band.

When the guard is placed in position, the band is opened wide enough to receive the collar and set-screw and is then allowed to spring into place. Such a band can be used on collars of different sizes. If, however, it be desired, the band can be made for special sizes. In order to save material, the construction shown in Fig. 2 has been devised, in which construction the band is formed at both ends with lugs straddling only the collar. The ends of the band do not overlap, but are separated and in contact with the collar at points remote from the set-screw.

The guard is easily applied and serves to prevent the clothing of workmen from being caught by the projecting part.

THE PIERCE CUSHION-FRAME, CHAINLESS BICYCLE.

In order to relieve the rider of the shock due to inequalities in the road, many bicycle manufacturers have provided their wheels with cushioning devices, the most common form of which is a coil spring located within the rear tube and yielding under the weight of the wheelman. But the spring-supported saddle has the defect of changing the distance between the saddle and the crank-hanger, and thereby causes a loss in the application of power. With the object of providing a cushion frame which would yield under the rider, but which would constantly maintain the distance between the pedal and the saddle, the George N. Pierce Company, of Buffalo, N. Y., have devised a novel arrangement which has very successfully withstood tests far more severe than those to which a bicycle is ordinarily subjected.



SECTIONAL VIEW OF PIERCE CUSHION-FRAME CHAINLESS BICYCLE.

In the Pierce chain-driven wheel, the usual spring is supplemented by a hinge-joint at the lower extremities of the rear forks and by a flat plate-spring connecting the crank-bracket with the lower rear tubes. From this construction it follows that, under the rider's weight, the entire frame will yield, and not merely the saddle, with the result that the distance between the saddle and crank hanger will always be constant.

In the chainless bicycle, it is evident that the flat plate-spring between the crank bracket and lower rear tubes cannot be used, and that some arrangement must be employed essentially different in construction but like in function.

With this end in view the driving-shaft bevel-gear is mounted within a crank-bracket composed of two side-pieces firmly fastened together. In a central raceway on the outer periphery of the bracket, balls are placed which are received by a corresponding raceway in a bearing ring rigidly connected with the lower front tube and the seat mast. The two side members of the crank-bracket, being firmly fastened together, rock on this bearing and, acting in conjunction with the cushion and rear hinge joint, serve the same function as the flat plate-spring previously mentioned.

Besides taking up the shock caused by obstructions in an uneven road, the cushion frame with its rocking bearing at the crank hanger possesses the merit of relieving the wheel of much of the strain to which a bicycle is subjected both in climbing hills and in riding over rough surfaces.

Human Hibernation in Russia.

It has been recently brought to light that the Russian peasant, in certain districts, suffers from a chronic state of famine, which occurs annually and is more or less severe, according to circumstances. In the official report given by the Bureau of Statistics of the Department of Pskov, some interesting facts are brought out, which seem to show to what extent man adapts himself to diverse external conditions in the struggle for existence.

In those districts suffering from a lack of crops, which has become almost a chronic state, the inhabitants have elaborated a method for adapting themselves to the want of provisions which is perhaps unknown in other parts of the civilized world. This means is called in Russia "lejka," signifying lying down or state of repose. It is in fact a kind of hibernation, as will be seen from the description which has been given.

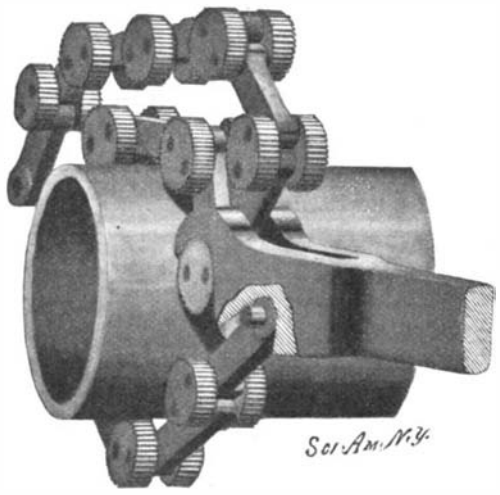
In those cases where the head of the family sees, toward the end of autumn, that by a normal consumption of his supply of wheat it will not last him until the end of the agricultural year, he makes arrangements to diminish the ration as much as possible; but knowing that in this case it will be difficult to preserve the functions at their normal height and to maintain the health and especially the physical force necessary for the work of the spring, he and his family plunge themselves into the "lejka," which means that everybody simply goes to bed, lying down upon the flat stove, according to the proverbial Russian custom, or in the warmest corners, during four or five months. He gets up only to replenish the stove, or to eat a piece of black bread dipped in water. The peasant tries to move as little as possible and sleep as much as he can. Stretched out upon the stove, he preserves the most complete immobility. His only care during the long winter is to expend as little as possible of his animal heat, and for that reason he tries to eat and drink less, move less, and to diminish in fact the vitality of the body. Each superfluous movement is translated into a corresponding diminution of energy, which in turn increases the appetite and obliges him to exceed the minimum of his rations; this minimum being regulated by the quantity of provision that will carry him over until the next harvest. Thus instinct commands him to sleep as much as possible. Obscurity and silence reign in the hut, where in the warmest places, either singly or crowded together, the members of the family pass the state of hibernation.

During the course of the famine of this year, the press has several times noted cases of this kind, but up to the present time it has been generally unknown that the lejka was not a temporary or accidental affair, but a regular system elaborated by a series of generations of peasants, who are accustomed to consider the half-ration as the rule, a sufficiency as an unattainable ideal, and hunger as an inconvenience to which he can "adapt" himself by the winter's sleep. It would be interesting to obtain further details as to this state of hibernation, as, aside from the moral question involved, it is of interest from a physiological and psychological point of view.

AN IMPROVED CHAIN PIPE-WRENCH.

A new chain-wrench for use upon pipe shafts and coupling-rods has been invented by Philip H. Bohner, of Peckville, Penn., and Charles A. Bohner, of Paducah, Tex., which wrench insures a firm, positive grip at all times, and an instant release when desired. Fig. 1 is a perspective view of the chain-wrench.

With each side of the links of the chain toothed gripping-disks are connected. To the end link a lever is pivoted, having a forked hook, the members of which freely receive the links, and also engage a pair of disks to close the wrench. When the chain is passed around a pipe and the hook engages the corresponding pair of disks, then upon swinging the lever upwardly, that part of the chain is tightened encircling the pipe.



A CHAIN-WRENCH FOR PIPES AND SHAFTS.

The toothed disks are firmly forced into engagement with the outer pipe-surface, so that the pipe is turned. The pivots for two adjacent links on a pair of disks are arranged diametrically opposite each other, so that the pull of the links is exerted in the proper direction when the chain embraces the pipe. Upon swinging the lever down, the forked hook immediately moves out of engagement with the corresponding pair of disks. Hence the chain is instantly released.

It will be observed that the forked hook extends forward beyond the point of connection of the lever with the end link. Consequently the hook does not completely disengage the pair of disks upon returning the lever for a new grip.

When the teeth on the disks are worn away, the chain can be reversed, so as to make use of the teeth on the other side of the disks.

Atomic Weight of Radium.

Demarcay's work on the spectrum of radium brought out the fact that as the proportion of the radio-active constituent in the barium chloride becomes greater, certain spectrum lines increase in brightness. The other conditions being equal, this gives a definite and valuable indication that the radio-active substance has a distinct existence apart from all known elements. Following up this hint, Sklodowska Curie has endeavored to determine the atomic weight of radium, or at least to get some information as to its order of magnitude. For that purpose she subjected to fractional distillation a mass of purified radiant barium chloride, obtained from half a ton of uranium residues supplied by the Austrian government. She further treated the chloride by fractional precipitation in alcohol. The highly active substance obtained was used for determining the atomic weight by means of the silver nitrate reaction. The values thus obtained varied from 140 to 145·8, as against the atomic weight of inactive barium 137·7 found at the same time. This of course leaves the atomic weight of "radium" indeterminate, but it is clear that radium is not allotropic barium, since no allotropic forms of an element have different atomic weights. And further, whatever be the atomic weight of radium, it must be greater than that of barium.—S. Curie, in Comptes Rendus.

THE department of water supply of New York city is now preparing specifications for filtering plants which the department intends to install at the Springfield pond in the Ridgewood watershed. This pond was cut off from the Brooklyn mains early in the summer on account of its pollution by several small towns.

Correspondence.

The Protection of Inventors.

To the Editor of the SCIENTIFIC AMERICAN:

Yours containing several copies of your "Patent Tricks" received and same forwarded to Hon. P. M. Jack, House of Representatives, Washington. He writes me saying he has received them and will do what he can in the matter. My own idea is that if a reprint of "Patent Tricks" was inclosed with every patent sent out from the Patent Office, that department would at least have done its duty in warning its patrons of the traps and swindles awaiting them. Letters to Congressmen in cases of this kind have great backbone stiffening properties, and one from you would, I think, have considerable weight.

EDWARD ROWE.

Indiana, Pa., January 8, 1900.

Liquid Air as a Blasting Agent.

To the Editor of the SCIENTIFIC AMERICAN:

In an article that appeared in your columns some months ago, I stated what was known about the trial of a liquid air explosive in the blasting operations connected with the construction of the Simplon Tunnel. There is an interesting article in the January number of Cassier's Magazine, dealing with the engineering features of this work. Some additional facts are given in regard to the liquid air explosive, the most interesting being contained in a foot-note. It is that the new explosive has been abandoned. It is to be remembered that the conditions surrounding its trial were especially favorable to it. This constitutes another "hard fact" to be pasted on the prospectuses of the heavily capitalized liquid air companies that are now most generously offering the investing public a chance, to share in the marvelous profits that must accrue to stockholders—if there were not so many hard facts that financial verbiage cannot down.

January 8, 1900. FRED. H. MCGAHIE.

HOW A WEATHER MAP IS MADE.

In most of our large cities weather maps are displayed daily in all public places and they are of great interest, not only to amateur meteorologists, but to the general public as well. Of course, the average person cares more about forecasts than he does about the map proper, but at the same time the number of those who daily consult the weather map is large. In New York city the Weather Bureau is on the top floor of the American Surety building, and the active work of forecasting and the preparation of the weather map is carried on in these rooms, while the observations are made on the roof. The local forecast official and his assistants reach the office early in the morning, for the forecasts are issued about 10 A. M. and maps are issued to the public about 11 o'clock, and a vast amount of preliminary work must be done. In addition to the local observations taken by means of self-recording instruments, telegraphic messages are received showing the observations taken at 8 o'clock A. M. in seventy-six stations of the United States; observations from Sandy Hook are also telegraphed in. Messages from the observing stations are all telegraphed to Washington and are in turn transmitted to all of the important stations from which weather maps are issued.

The Weather Bureau possesses a remarkable code system of telegraphing. The exact condition of the weather of New York city might be given by the following cipher telegram: "YORK—BINNACLE—HUNNEWELL—RENOWN—OUTMOST—FOG—PERMIT." Messages of the same length from each station are received by the telegrapher, and from these messages the observer, or the local forecasting official, as he is termed, makes up his weather map and from them he gets valuable information for his forecast as to meteorological conditions all over the country.

We will now analyze the telegraphic cipher report of the observations given above. "York" is simply the cipher-address indicating the location of the station; the word "Binnacle" is a special code word for both the barometric pressure and the temperature. If, for example, the barometer should be stationary for two or three days, and the temperature varied, different words would be used each day at the same time; a syllable of the word telegraphed each day would indicate a stationary barometer, while a key to the changing of the temperature would also be given. In "Binnacle" the first two letters, "BI," mean 30·16 inches barometric pressure, and "NA" indicate a temperature of 62 degrees Fahrenheit. The next word, "Hunnewell," refers to precipitation, the "NE" being the significant syllable indicating a precipitation of 0·64 inch. In morning reports "H"-words are used, and at night "L"-words are used. The word "Renown" indicates the direction of the wind, the state of the weather and maximum temperature for the last twenty-four hours. If the word begins with "R," it is understood that the wind is west, but if the word begins with "F," the wind is east. The "E" following the "R" indicates cloudy weather, while the syllable "NO" indicates a maximum temperature of 68 degrees. The word "Outmost" refers to the velocity of the wind and the minimum temperature for the last twelve hours. The word "Fog" is not a cipher word, and fully explains its meaning. The word "Permit" means that the maximum wind velocity in past twelve hours was 56 miles from the west. The observers are very expert in handling these ciphers, and a message of this kind is translated almost always without the aid of the large code book. The code system, as has already been said, is most elaborate, and is based on the value of certain letters in certain positions. Thus, A=2, E=4, I=6, O=8, U or Y=0, B=1, D=2, F=3, G=4, M=5, N=6, R=7, S=8, T=9; thus, in the word "Binnacle" the "NA" will be seen to have the value of 60+2, which, of course, means 62 degrees, the "A" being in the units place.

With the aid of all these observations, which are taken from telegrapher to the forecaster, the latter makes his map.

Blank weather maps are used, and he indicates on one of them the various barometric pressures and temperatures. He then draws the "isobars" or continuous lines on the map which pass through points of equal air pressure. He then draws on another map, with a different colored pencil, the "isotherms," dotted lines which pass through points of equal temperature. Various symbols indicate the state of the weather. Thus, a circle indicates "clear;" if one-half of it is black, it is "partly cloudy," or if all black, it is "cloudy;" an "R" within a circle means rain; "S," snow; and if a report is missing, an "M" is put in its place. An arrow which passes through a circle indicates the direction of the wind.

As soon as a map is made in manuscript, it is given to an engraver, who transfers it to a chalk plate. He uses three maps for the purpose, one showing the state of weather and the direction of the wind, one for the isobars and the other for the isotherms, and, while he is doing this, the forecast official is making up the forecast for the day.

The chalk plate process is very rapid, and has been found to possess marked advantages over the old styles of duplication, in which stencils were perforated, as in the neostyle and cyclostyle processes. In brief, the chalk plate outfit consists of a blued steel plate covered with a composition unaffected by heat, which adheres firmly to the plate. The composition can be made of various materials; an article on the subject was published in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 720, dealing with the technical side of the composition. The idea of the process is to scrape away the portion of the chalk covering where the lines or lettering are to appear on the printed map. This is done with the aid of a stylus which somewhat resembles a bent pin. A new plate is used for each map, and the composition is then scraped off and the plate is sent away to be recoated. The engraver places one of the maps over the plate and lightly scores the various points which he is to engrave with an agate stylus. It should be understood that the plate when finished will consist only of lines, symbols and figures. The map proper, showing the contour of the country, its political divisions, cities, natural features and observing stations, is, of course, lithographed in large quantities and sent to the observing stations.

STEEL STYLUS FOR CHALK PLATE WORK.

A small steel instrument is used to make the circles. This instrument somewhat resembles a small pair of compasses and rests on a large foot to avoid removing any of the chalk surface. After the circles have all been put in, the operator indicates the state of the weather, that is to say, he may scrape out all of the chalky material which the circle circumscribes, thus indicating rain, or only one-half of the circle may be taken out, indicating partly cloudy. Letters in the circle where necessary are put in with a stylus, and the direction of the wind is then indicated by oblique lines and arrows. In doing this work a stylus provided with a rubber tube is used. The engraver squeezes a bulb connected with it, and the air passes down the handle of the stylus and through a small opening and serves to blow away the chalk dust caused by the cutting. After this is completed he then takes the second map from the forecast official, showing the isobars. They are transferred to the chalk surface with the aid of a stylus, as above. They are rapidly cut out by one of the steel points as shown in our engraving. It does not usually take more than three or four minutes to perform this operation. The barometric pressures are then written in with the aid of the ordinary stylus.

The map containing the isotherms is then treated in the same way, and the temperatures are located on the map at the termini of the lines. What are termed "highs and lows" are then put in. These words are printed from type at the proper parts of the map. A small portion of the chalk is scraped away to admit of a slug, and after the casting this slug is knocked out and the type word cut in brass is inserted. The plate is then dusted off and is taken to the basement, where it is put in a casting box, and, after being warmed, hot stereotyping metal is poured on the face. Wherever the steel point has removed the chalk surface the metal flows, making a sharp cast. After cooling, the stereotype plate is removed, and it is then sawed to shape with a jig saw. It is secured to the press by lugs cast on the plate, and the brass type is inserted in the three or four places which have been left for them by the slugs. The printing press is across the hall from the offices, and it has the unique distinction of being the highest printing press in the world as far as being artificially raised is concerned, as it is nearly 300 feet above the street. It is driven by electricity, and as fast as the maps are printed off they are at once put up in wrappers and are sent out to the post office.

The bottom of the weather map contains the forecast, a brief note on the weather conditions, and the observations taken at eight A. M. from all parts of the country which have been received in cipher by telegraph, as already explained. About 800 of the maps are issued in New York, and they are usually all printed by eleven o'clock. The forecast is usually completed by half past nine o'clock; the maps are sent to various hotels, public buildings, etc., where they will be displayed for the benefit of the public. They are sent by mail and are treated as first-class matter. The Weather Bureau is connected with the telephone exchange, and a large number of forecasts are given out over the telephone to inquirers. We are indebted to Mr. E. H. Emory, local forecast official at New York city, for courtesies in preparing the present article.

Automobile News.

During the month of December, according to the Paris edition of the Herald, 708 accidents were caused by horses, resulting in 52 deaths and 656 injuries. In the same period there were only 21 automobile accidents and only one death.

From a picturesque point of view the old stages will be missed from Fifth Avenue when the new automobile stages are introduced, but the advantages will be much greater. A conductor will necessarily have to accompany each omnibus, and the driver will no longer be compelled to dole out tickets and change in envelopes, but can give his undivided attention to running the vehicle.

In a recent article in The Medical News, Dr. J. J. Walsh points out that there are certain diseases which will greatly diminish as the result of the absence of the horse from the city's streets. Tetanus, for instance, will probably disappear almost completely. It is on horse fodder that the germ is introduced into cities, and with the elimination of the horse, that dread disease lockjaw will probably almost disappear.

In Paris an automobilist was driving an automobile at an excessive rate of speed, and the driver of a tram car was doing the same thing. They crashed together, and a lady was caught between the two vehicles and her leg was broken. The automobilist was sentenced to two months' imprisonment without the benefit of the first offense law, and the driver of the tramway sentenced to eight days' imprisonment with the benefit of this law, and they had to pay jointly $3,000 damages.

The congestion of travel in London between the east and west costs the trade interest of London more than $10,500,000, according to Sir J. Wolfe Barry. He would correct this by cutting a single mighty street 125 feet wide, 5½ miles long, from east to west, and this, with its subsidiary connections, would cost $30,500,000. Should London continue to advance in the next twenty years as it has done in the past twenty years, something of this nature will have to be considered. The automobile will undoubtedly assist in straightening out the confusion.

Purple Rainbow.

The Grand Duke Leopold Ferdinand gives an account, in the Meteorologische Zeitschrift, of his observation of a purple rainbow on the 8th of August last, near Przemysl. This locality has an altitude of 270 meters. During the night a heavy dew had fallen; near morning the temperature was 12° C. At the northeast appeared somber nimbus clouds, when at 3:45 A. M. the zenith assumed a strong reddish tint, this color increasing toward the northeast, and at 4 o'clock appeared a rainbow of exceptional width and of a pure dark purple; its summit was 35° above the horizon. After four minutes a second rainbow appeared, about 10° from the first, of an equal width, having a pale rose color. In the principal rainbow the purple color dominated, but the outer border was tinged with violet, and the inner edge was of a cherry red hue; its summit gradually ascended to 50°. At 4:16 the exterior secondary rainbow took an orange tint, then disappeared. The outer edge of the other became lilac, and the interior a pale cherry; by degrees, this latter color extended itself over the whole width of the rainbow, which finally assumed an orange tint.

Science Notes.

We regret to note that Natural Science has been discontinued. It was recently published by Young J. Pentland, of Edinburgh, and was one of the best scientific periodicals in the world.

At the time of the recent meteoric shower it was stated that a meteorite partially wrecked a residence near Webster City. Iowa. On investigation it was found that the alleged fall of a meteorite did not occur.

M. Curie and Mme. Curie have forwarded a note to the Paris Academy of Sciences, in which they state that radio-active chloride of barium possesses the property of converting oxygen into ozone—which is proof that the radiation represents an expenditure of energy.

Bernard Quaritch, prince of booksellers, died recently in London. He was famous as a dealer in rare and valuable books. Many of his catalogues of scientific books were valuable from a bibliographical point of view. In the course of his career he handled large quantities of scientific books.

Prof. E. P. Allen calls the attention of The Chemical News to a case of corrosion of gold-plated weights which had been put away for the summer in a safe. It is thought that the corrosion was caused by mold, the gold-plate, perhaps, not being completely impervious, and the zinc being removed from the brass.

The American Society for the Promotion of Agricultural Science has approved the action of the Massachusetts Legislature in maintaining the Gypsy Moth Commission and carrying on the important work of exterminating the mischievous moth. Our readers will remember the interesting article we had on the subject a short time ago.

Some months ago we gave an account of the removal of the stomach of a lady who lived in Boston. The operation was a surgical success in every way, but the patient never recovered health, suffering intensely, and the suffering increased until the time of her death. Her prolonged life is evidence, however, that the stomach is not absolutely essential to human existence.

An investigation has been made by the Egyptian government into the recent fall of the columns of the Hypostyle Hall at Karnak. The commission appointed to make inquiry into the cause of the disaster concludes that it was mainly due to the removal of debris from the floor of the Temple, which had acted as a partial support to the columns, and that owing to its removal the water had some play around the bases of the columns. This indicates that this architectural monument is in a precarious state, and it is hoped that every effort will be made to prevent further damage.

The number of Leonid meteors observed at the University of Denver during the recent meteoric shower of November seems to have been larger than in most other places in the United States. We are informed by the Director of the Chamberlain Observatory, Prof. Herbert A. Howe, that a corps of volunteer observers did the counting on the morning of November 16, under the direction of Prof. Spencer. The number of Leonids counted was 204. There was, however, some duplication of the work because some of the observers simultaneously watched the same quarter of the sky. After making a deduction for this, 150 is the probable number of separate meteors counted. The work was considerably hindered at times by clouds, as was the case on the mornings of November 14, 15, 18, on which Prof. Howe saw 30 Leonids; the sky was totally overcast during the morning hours of November 17, so that no meteors were seen. Photographs were made on the morning of November 16, but the results were meager.

Dr. William A. Hammond, who was formerly Surgeon-General of the United States Army, died January 5, at his home in Washington. He received his commission as Assistant Surgeon in 1849, and served in the West for several years. He was afterward appointed Professor of Anatomy and Physiology in the Maryland University School of Medicine. When the Civil War began, he gave up his position and again entered the army In April, 1862, he was offered the position of Surgeon-General of the Army with the rank of Brigadier-General, which he accepted. He introduced a number of radical changes, and charges were brought against him, and he was dismissed from the army in 1864, but in 1878 a bill was submitted to Congress authorizing the President to review the action of the court-martial, and in 1879 President Hayes restored Dr. Hammond to his place on the rolls of the army as Surgeon-General with the rank of Brigadier-General on the retired list. He had an extensive practice in New York, and was Professor of Diseases of the Mind and Nervous System in Bellevue Hospital Medical College and in the University of the State of New York. In 1882 he was one of the founders of the New York Post-Graduate Medical School. He was the author of a number of medical works, and was one of the originators of The New York Medical Journal; he also established The Quarterly Journal of Psychological Medicine and Medical Jurisprudence; he also devoted some attention to lighter literature.

Engineering Notes.

In Buffalo, when a street car barn was being built recently, it was impossible to obtain steel within the required time, consequently old discarded street car rails were used instead.

The Metropolitan Street Railway Company will run open cars for passengers on the Madison and Fourth Avenue line all winter, which will enable those who smoke to be accommodated. The cars are combination cars, part of the car being closed and part opened.

The Empire State Express now has a seating capacity of 257 passengers. The two day coaches have seats for 86 passengers. The smoking car contains 50 seats, and the parlor car 35 seats. The day cars, says The Railroad Gazette, have wash basins, soap and towels at either end, and the porter can be summoned with the aid of electric push-buttons.

Melinite was originally picric acid embedded in a collodion solution, and later on also fused picric acid. A mixture of fused picric acid and cresylic acid is now employed. Although picric acid was used as an explosive in the pulverulent state, mixed with saltpeter and other ingredients, yet the property of detonating with great violence when melted was first indicated by Dr. Herman Sprengel, and afterward patented by Eugene Turpin, of Paris.

The new Cunard steamer "Saxonia," which was launched on December 16, was the largest vessel ever built on the Clyde. The "Saxonia" and the sister ship were primarily designed for cargo carriers, the passenger requirements being subordinated to this aim. The name of the sister ship is "Invernia." The tonnage is close to 14,000, the length over all 600 feet, breadth 64 feet 3 inches, molded depth from upper deck 41 feet 6 inches. There are four principal decks.

Lyddite is simply picric acid brought into a dense state by fusion. The shells are coated inside with a special varnish, and the melted picric acid is cast into them. As this requires a strong detonator, or a very powerful primer, the government is said to have adopted a primer of picric powder, which consists of a mixture of two parts of ammonium picrate to three parts of saltpeter, manufactured in much the same way as ordinary granulated gunpowder. This is then set off by the ordinary service fuse, says The Engineer.

A firm in Dresden is offering a novel kind of fencing against drifting snow. It consists of a cocoanut matting, or rather netting, the meshes of which are about 1½ inches wide. The mats are usually 13 × 5 feet, says The Railway Gazette, and are lashed at the ends to posts which may be made of old ties, with truss ropes at the top and bottom. These fabrics offer very little resistance to the passage of light and air, but almost perfectly arrest snowflakes and do not decay when wet nor break when dry. In summer they may be rolled up and stowed away.

The Czar of Russia has three small daughters whose chief nourishment consists of milk, and as experts in the rearing of babies commend the use of milk of one cow, the little princesses take the cows with them on their travels. When they were taken on a recent visit to the Emperor of Germany, a palatial stable car was attached to the imperial train, and in this car were two stately Holstein cows which supplied milk fresh, warm and of a uniform quality as the children required it. The Railroad Gazette states that when the two august emperors fell on each others' necks at the stations at Potsdam, the awed spectators were somewhat startled to hear a lusty "moo" from the train which had just brought the Czar.

For some time past inventors have been looking for a device by which paper may be fed automatically to the printing press. M. Rymtowtt-Rives, of Geneva, has, after six years of work, perfected a device which accomplishes this operation in a satisfactory manner, and has lately applied it with success to several large presses in that city. This automatic feeder may be applied to all kinds of printing presses, as well as to letter and folding machines. It is very simple in construction, and the changes necessary to accommodate the different sizes of paper may be easily and quickly made. The device consists of two distinct parts, the feeder proper and the distributer; the feeder has two movable arms carrying jaws at the ends which take up the sheet of paper on the upper table and bring it to the level of the inclined table below, where the arms of the press carry it to the form. The feeder includes also the mechanism operating the air-exhaust for the suckers which take up the first sheet and place it in the jaws. The second and most important part of the apparatus is that called the distributer; this is placed on the rear of the upper table containing the pile of paper, and its office is to separate the first leaf from the pile and prevent the suckers from drawing off more than one leaf at a time, no matter at what speed the machine operates. Upon the success of this device depends the working of the whole system. In fact, the improved apparatus has been found to work very satisfactorily at all speeds, and will take any thickness of paper.

Electrical Notes.

A system of electric haulage has been installed on the Charleroi Canal in Belgium, the distance being about five miles.

The German courts have decided, on several occasions, that the theft of electrical energy was not punishable by law, as electric current or electrical energy could not be considered as a material object. A bill to remedy this state of affairs has now been laid before the German Federal Council.

Recent experiments with a view to connecting Brussels and London by telephone have been very successful, and it is probable that in a short time a regular line will be established. There is a telephone already working between Budapest, Vienna and Berlin, and in a short time it is expected that Berlin will have telephonic communication with Constantinople.

A new Mexican electric railway system is proposed to make connection with the railway system of Central Mexico. If it is built, it will extend for 409 miles, and the estimated cost is $14,000,000. Of this sum, the Federal government will give $6,000,000 and the states of Campeche and Tabasco will be asked for subsidies, as they will be the principal sections of the country served.

The first electric launch in Venice has been delivered. It accommodates about fifty passengers and is 56 feet long and 10 feet wide. Its average speed is 7 to 10 miles an hour, and it is called the "Alessandro Volta." While the introduction of any mechanical form of propulsion other than the gondola is to be regretted as far as Venice is concerned, still, if launches of this kind take the place of the small steamboats on the Grand Canal, it would be a great improvement.

An interesting question has arisen whether there can be a tariff on electricity. One concern on the Canadian side of Niagara Falls proposes to extend its lines to as many points as possible in the United States, selling its light and power to all the customers obtainable. This business would, of course, compete seriously with the power companies on the American side of the Falls, and the latter have been in communication with the United States Treasury Department relative to the matter. The Secretary of the Treasury has submitted the question to several leading collectors of customs in various parts of the country in order to obtain their opinions. If it is decided that the current generated is dutiable, it will be under the authority of the "drag-net clause" of our last tariff law, which makes all unenumerated manufactured articles dutiable at 20 per cent ad valorem. The case is a most interesting one, and is somewhat similar to the natural gas question, which came up five or six years ago. Natural gas was piped across the Niagara River from Canada. Duties were assessed on the gas, and the matter was finally taken to the Supreme Court of the United States, which held that no duty could be levied.

Following upon the opening of the Dortmund-Ems Canal, in Germany, an interesting series of tests is now being made to determine the practicability of electric traction for the canal boats of this system. The trials have been carried on in the neighborhood of Eberswalde, on the canal of Finow, under the direction of the government. The electrical installation has been furnished by Siemens & Halske. The results obtained have been on the whole satisfactory, and it is expected that before long this method of traction will be put in practical operation. The Lamb and Koettgen systems have been tested over distances of 300 and 1,000 meters respectively. The routes have been chosen so as to encounter all the different kinds of obstacles and difficulties which are to be found over the whole length of the canal, such as bridges, locks, sharp curves, etc. By the Lamb system, the traction is carried out by the aid of small locomotives which travel upon wire cables, 32 millimeters in diameter, fixed to strong posts along the bank about 4 or 5 meters apart. The current is not transmitted by these cables, but by a system of contacts contained in a special conduit. The locomotive will give 5 horse power and weighs about 900 kilogrammes. By this means the speed of traction reached 1 meter per second or about 4 kilometers per hour; this system works very well in practice, its only inconvenience being in the passage of sharp curves. The Koettgen system uses also a small locomotive, which runs on rails along the bank, these rails being arranged so that one of them carries 85 per cent of the weight, the other insuring stability. The current is taken by a contact wheel which runs along a conducting wire. The locomotive designed for this purpose has a weight of 2,000 kilogrammes, and the average speed is 4½ kilometers per hour; it is strong enough to haul three loaded boats or two loaded and two empty. The cost of traction amounts to about 0·1 pfennig per ton-kilometer, and if the traffic is carried on extensively, this figure will be still more reduced and will give an economy of transportation which has been valued approximately at 4,000,000 marks per year. This system has, besides, the advantage of being able to furnish light and power to all points in the region of the canal.

DISCOVERY OF CLIFF DWELLINGS IN THE SOUTHWEST.

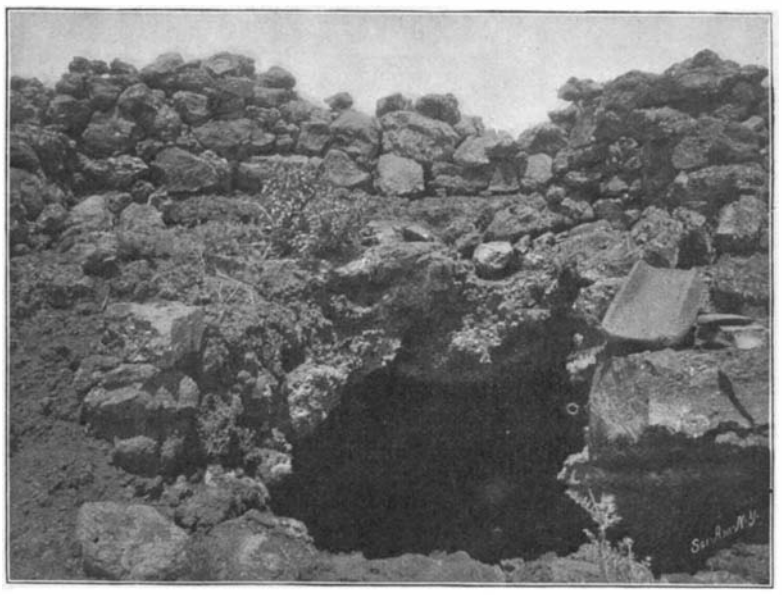
BY GEORGE WHARTON JAMES.

It was recently asserted that all the cliff dwellings of Arizona and New Mexico were so well known that they were platted and recorded with fidelity and accuracy. This statement is one that no reliable writer and explorer of that region could make, for ruins are being discovered continually, the very existence of which no one had ever imagined.

The cliff dwellings to which my attention for some years past has been directed are those as yet unreachable and untouched ruins known to exist in the upper reaches of the Shinumo, an exquisite and beautiful mountain stream that flows from the north slopes of the Kaibab Plateau and empties into the dirty red waters of the Colorado in the Granite Gorge, a mile or so below the foot of the Mystic Spring Trail. The region is the most wonderful and stupendous canyon yet discovered in the world. To the east is the Point Sublime of Capt. Dutton, its pine-clad summit silhouetted against the clear Arizona sky; and to the west is the even grander and more sublime point of Powell's Plateau, which I have named after the great geologist and brilliant writer, Dutton Point. The Shinumo has two upper forks, both of them difficult to reach and portions of which are inaccessible. The great amphitheater which extends from the two before-mentioned points is named by Dutton the Shinumo Amphitheater, and he spent months in exploring the region. Yet he never mentions these cliff dwellings, nor does Major Powell, to whom also the world owes much of its knowledge of this country.

Mr. W. W. Bass, the owner of the Mystic Spring Trail into the Grand Canyon (which is located about some forty-five miles west of the old camp reached from Flagstaff), has, for years, been endeavoring to reach these cliff dwellings. At great expense he has constructed miles and miles of trail leading toward them, and each year sees him nearer. A number of dwellings have already been reached, but the main collection is, as yet, inaccessible.

Starting down from the head of the trail on the south wall of the Grand Canyon, a ride of about a mile, cutting through the cherty limestone, brings one to the cross-bedded sandstone. Here, near the point of contact of the two different rock formations, are some cliff dwellings, one of which is reasonably accessible, and, not far away, Mr. Bass found three immense natural cisterns, eroded out of the sandstone, and which the Havasupais tell us were used centuries ago by their ancestors, who dwelt in the cliff dwellings of this portion of the Grand Canyon.



CAVE DWELLING NEAR FLAGSTAFF, ARIZONA.

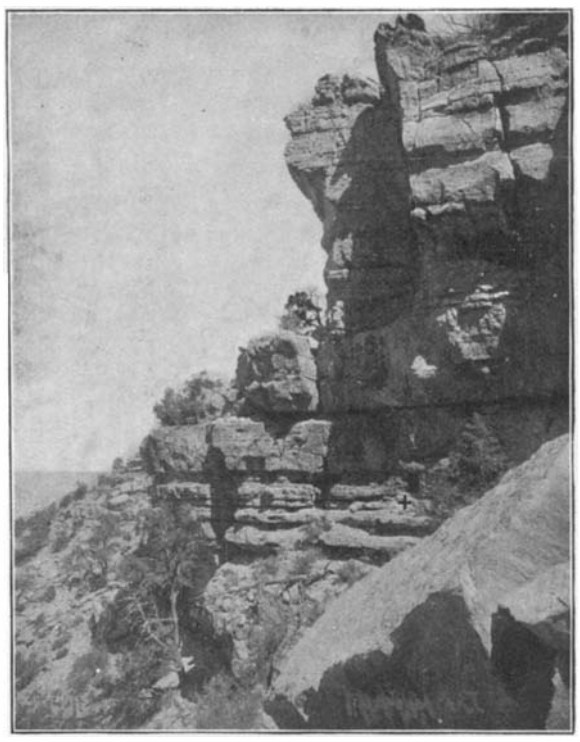
After crossing Le Conte Plateau, upon the red sandstone, the trail twines and twists around points and over ledges, dodging back and forth, ere it descends to the marble. Here the canyon narrows for a mile or so, ere it opens upon a large but uneven plateau over which the trail descends to the granite. From this point we look across to the massive rock structures of the north side of the river, two of which are boldly outlined against the cloud-flecked sky. These are Bass Tomb and Dox Castle. Between these two the Shinumo wends its winding way to the great Colorado.

At last the river is seen, and, as we stand upon the upper cliffs and look down into its muddy and turbulent depths, we are lost in amazement at the daring of Major Powell and his brave band of men, who fearlessly explored this then unknown and much dreaded river of cataracts, whirlpools and rapids. The water seems smooth and easy flowing at this distance, but as we approach, its dangers are more manifest. Immediately below where we stop for awhile with our horses begins a fierce and roaring rapid, while to our right up the river, the water is churned into reddish creamy foam as it comes through the dark and cruel fastnesses of the Granite Gorge.

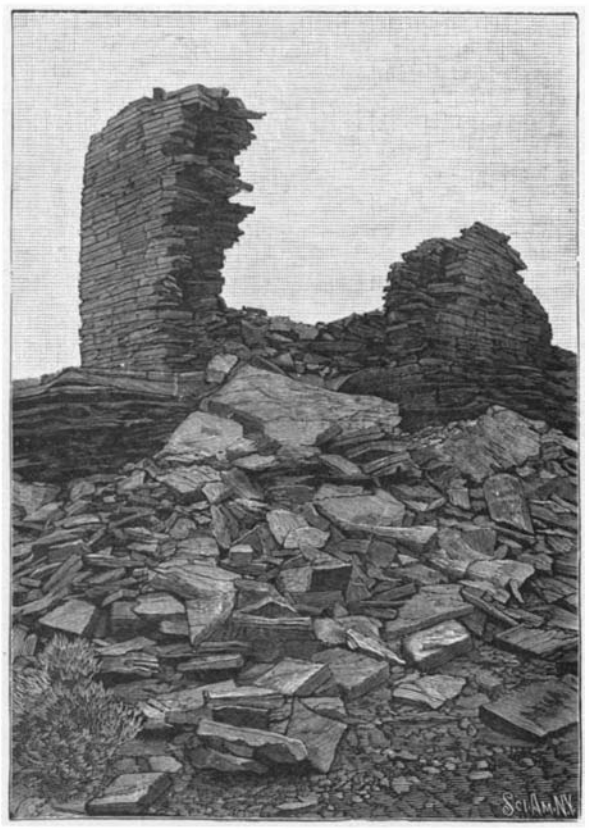
But before we cross we ramble down, more often it is a scramble, over the granite rocks for a mile or so, until we stand almost opposite the narrow chasm through which the Shinumo flows into the Colorado. Here are diverse elements of interest in the muddy, red waters of the Colorado, the glowing colors of the rocks, and the sweet, glistening, clear purity of the inflowing Shinumo. Before us is a colossal basic pillar that stands guard at the entrance and which positively forbids admittance to the secret precincts of the sweet-watered creek except to those who are willing to cast off all clothing, and, naked, advance into the mystic shrine.

The crossing of the river is attended with no little danger. In a rude lumber boat, rudely constructed, rowing with rude oars, and aided by my Mormon guide, Mr. R. M. Bleak, I braved the dangers and defied the rapids which roared above and raged below us. It was only a few weeks before that a poor fellow, attempting to cross with a companion a few miles higher up, was thrown into the swirling waters and, alas! was never seen again. Whether he was drowned, or dashed to pieces against the cruel granite walls, or escaped from both these deaths, only to suffer the more cruel death of starvation in these prison walls, the day of revelation will alone tell.

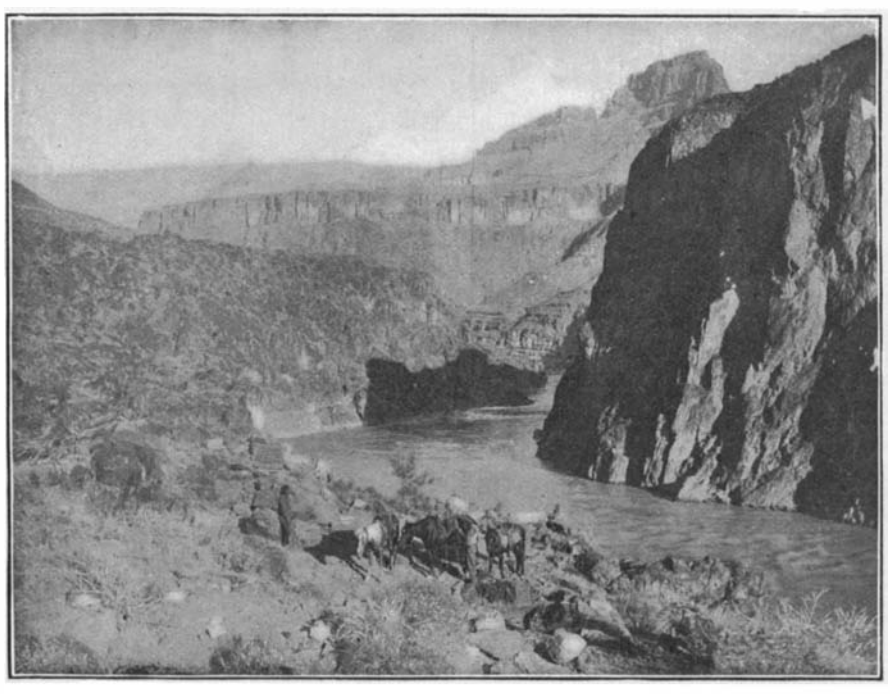
On the other side, with heavy packs on our backs we wearily trudged over the burning rocks and finally clambered down a wall of broken rock to the very side of the restful and inviting Shinumo. On our way, however, we passed over a most interesting prehistoric trail, where it was plainly to be seen the aborigines had removed the rocks from the pathway. This trail led to a wild chaos of fallen bowlders and rocks, over which it seemed, at first glance, as if no one could ever find a way that could be followed a second time. To Mr. Bass' great surprise he discovered here a well laid out and worn trail, the key to which was made by a rude "blazing" of the rocks all the way across this "rocky river." The Indians had evidently taken their rude hammers or axes and pounded the stones on



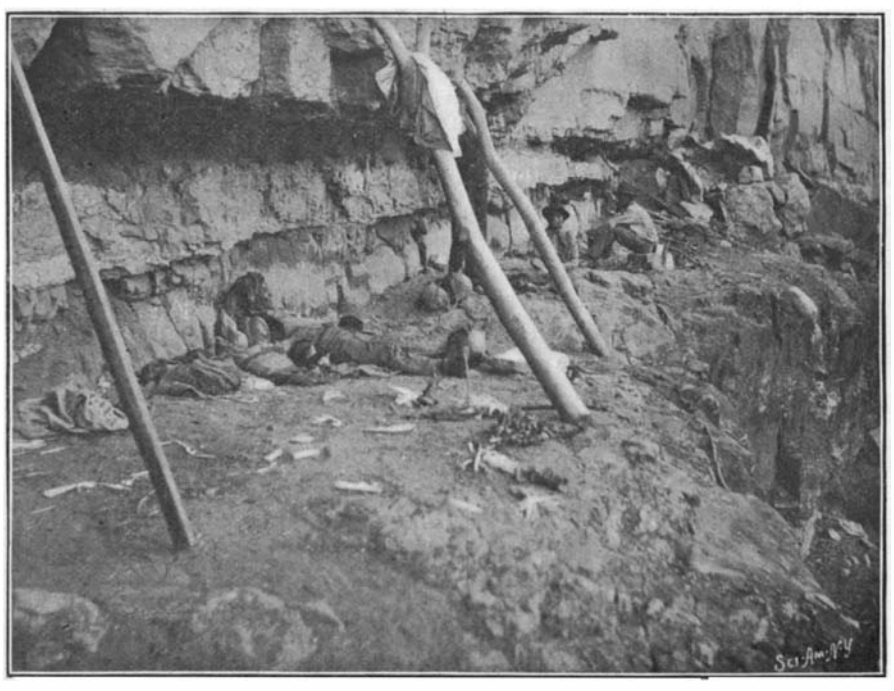
CLIFF DWELLING ON THE MYSTIC SPRING TRAIL.



RUINS ON THE LITTLE COLORADO.



A RAPID IN THE GRAND CANYON.



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WA-LU-THA-MA'S NEW CLIFF DWELLING SITE.

either side, just as in later days the pioneers with ax in hand chipped off the bark of the trees, and blazed their way through the trackless forests.

But what a delight the clear, cool, pure water of the Shinumo was to one who for days had been drinking the lukewarm nastiness of pool water, or the muddy and silty water of the Colorado. Not far from where we camped I found two tiny cliff dwellings, securely sheltered in the rocks above a large level area which undoubtedly had been used as a garden in years long passed.

These cliff dwellings were of that diminutive character that led the early day explorers and writers to speak of a pygmy people — dwarfs, doubtless, who alone could have dwelt in such limited space. From the Havasupais, however, I learn positively the hitherto only conjectured use of these small houses. They are not and were not dwellings in any sense of the word. They were merely used as storage houses for their corn and vegetables, and were so constructed that their produce could be safely placed therein, sealed up, and thus kept secure from the depredations of animals. A number of these small "meala-hawas" were found, and several real dwellings, but only one of the latter was accessible, and an unfortunate fall of my horse broke the plate from which I hoped to secure a good photograph of it. For ten miles we were able to follow the winding Shinumo on the trail already made, and then we came to a full stop. The old Mormon trailmaker calls this great "exclamation point" "the devil's elbow," and surely it seems a very devil of an elbow to get around. Dynamite will have to be used ere it can be passed and the upper dwellings (which can clearly be seen from walls above) reached.

Nor are these the only cliff dwellings that have not yet been explored. In one branch of the wonderful Ha-va-su Canyon (commonly known as Cataract Canyon) are scores of these dwellings and meala-hawas that no white eyes but my own (according to the statements of the Indians) have ever gazed upon. The weary work of reaching these precluded my taking the camera on my first trip beyond a certain point, where I was glad to leave it, but near here is a dwelling I hope some day to explore. It is so high up and so far within the hollowed-out walls that at present it is inaccessible.

An interesting fact about these dwellings is that the Havasupais have positive traditions as to their occupancy by their own ancestors, and, furthermore, on my last visit to this most interesting people, in July and August, 1899, I found my host, Wa-lu-tha-ma, about to go back to the cliff dwelling houses of his ancestors. Our engraving shows the site on edge of a forty or fifty feet high precipice where he was just beginning the erection of a cliff house. Though he has two wicker "hawas" in the valley, he prefers a stone house, where, as he himself informed me, he expected to be able to keep dry when it rained. Nor are these all the recent discoveries. Engraving No. 4 shows one portion of a large house near the banks of the Little Colorado which has never been explored, described or platted, and in the region of the Grand Falls and Black Falls, both on the Little Colorado, I have had the Mokis and Navahoes take me to ruins and cliff dwellings that they assure me they themselves have only recently discovered.

There is also an interesting ruin on the summit of a vast isolated rock mass, just above Willow Spring, which the Navahoes pointed out to me as I was journeying once to Lee's Ferry. This has never been described or explored. It is inaccessible, and I had to climb up the steep walls of Echo Reef ere I was able to secure a view of it.

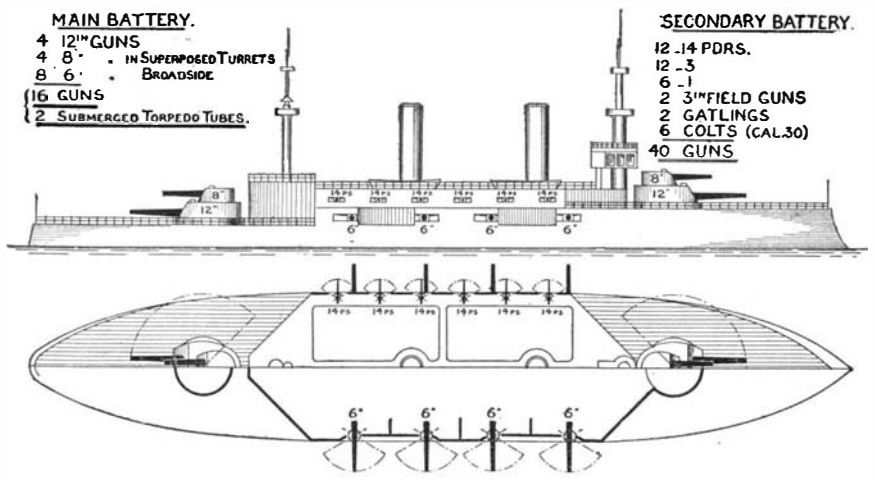
It may be a matter of interest to show here one of the many Caveate dwellings found near Flagstaff, Arizona, and which were doubtless occupied by the same people as the cliff dwellings. The caves are either natural blowholes enlarged by rude methods or were hewn out of the softer lava deposits. Many of these caves have been explored, and the relics found are of the same character as those of the cliff dwellings.

I am satisfied there are scores of cliff dwellings in Arizona and New Mexico yet to be found, and I am glad to have the opportunity the wide and thoughtful clientage of the SCIENTIFIC AMERICAN affords me to urge upon all travelers into this region the most thorough and careful search for places and dwellings of the prehistoric peoples regardless of the assertions made that such search will be in vain.

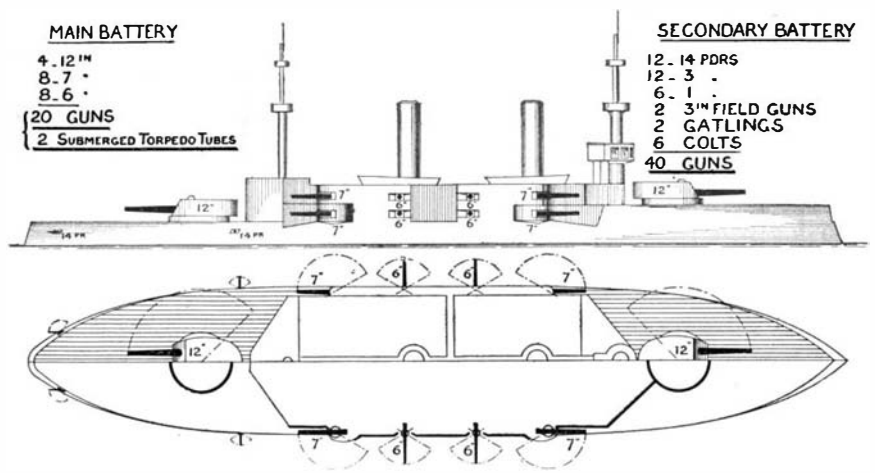
THE ARMAMENT OF OUR LATEST WARSHIPS.

We present illustrations of our latest long-caliber guns, and also of the proposed armaments of the three first-class battleships, "New Jersey," "Georgia" and "Pennsylvania," authorized by the last Congress. In the last report of Rear-Admiral O'Neil, Chief of the Bureau of Ordnance, reference was made to the new ordnance which is being constructed for the batteries of future warships. These guns are to use smokeless powder, and develop vastly greater energy, gun for gun, than the old brown powder guns, which were so largely in use during the war with Spain.

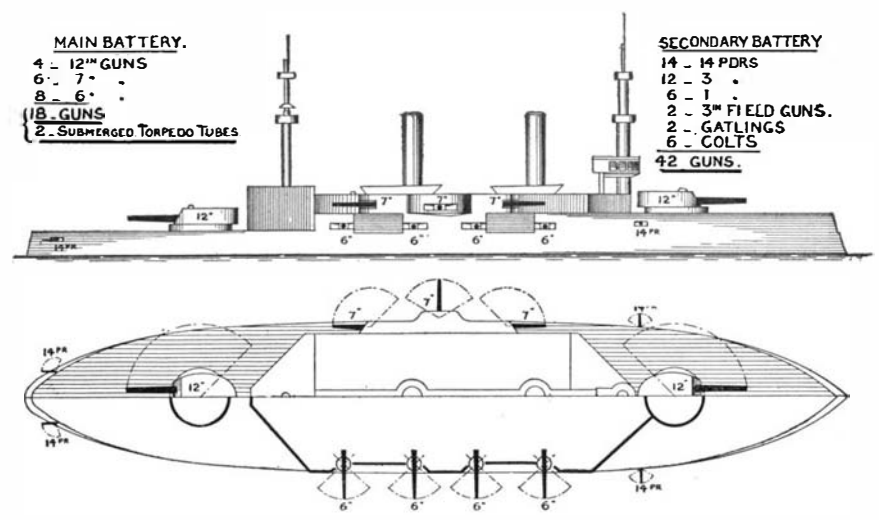
The explanation of the remarkable changes in our navy guns, as shown in the accompanying comparison of various patterns in use during the past fifteen years, is to be found chiefly in the qualities of the powder. The old black powder of the civil war was a quick powder—the charge being almost instantly converted into gas at the instant of firing; the brown powder used in the Spanish war was slower burning than the black powder, but quicker than the smokeless powder, which burns, for an explosive, at a very slow rate, and gives off enormous volumes of gas. The slow combustion of smokeless powder necessitated a longer bore, to give the powder time to be completely consumed, and it is by the large powder chamber, big charge, slow combustion and sustained acceleration in the long bore, that the modern long-caliber gun achieves its wonderful results, the projectile of the new 6-inch gun leaving the muzzle with a velocity of 2,900 feet per second.



Design 1.—Armament and ⅔ Ammunition 951 tons—7·03 per cent of 13,500 tons.

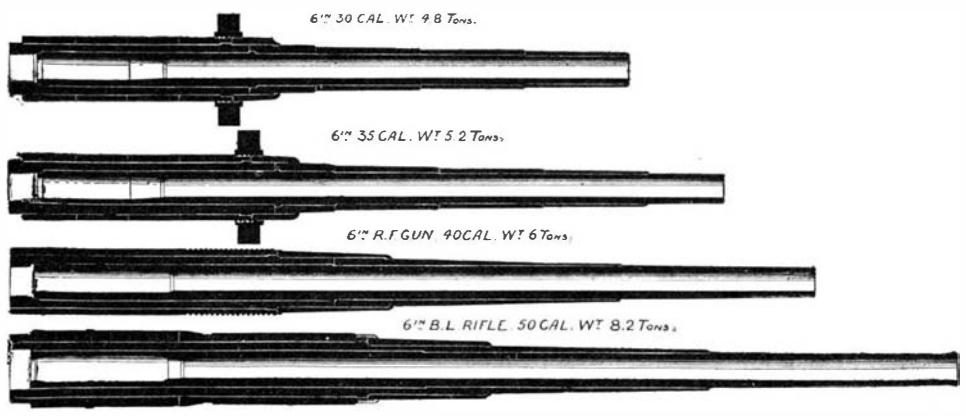


Design 2.—Armament and ⅔ Ammunition 1,043 tons—7·72 per cent of 13,500 tons.



Design 3.—Armament and Ammunition 989 tons—7·32 per cent of 13,500 tons.

PROPOSED ALTERNATIVE ARMAMENTS FOR NEW 13,500-TON UNITED STATES BATTLESHIPS.



COMPARISON OF FOUR PATTERNS OF 6-INCH GUN FROM 1883 TO 1899.

The built-up gun of 1883 consisted of an inner tube extending from breech to muzzle; a jacket and a set of chase hoops shrunk on over the tube; and a set of jacket hoops shrunk on over the jacket, while over these was a ring carrying the trunnions. In the 40-caliber gun, the many chase hoops have given place to one long hoop or two, while in the 50-caliber weapon the construction is simplified to an inner tube, a single, long jacket and three jacket hoops. The substitution of a long jacket and a few long hoops for the many short hoops of the 30 caliber gun not only cheapens construction but adds greatly to the transverse strength of the piece.

By the courtesy of Rear-Admiral O'Neil we are enabled to present the accompanying table, showing the ballistics of the new naval guns (1899 model). They are all built according to the improved principles shown in the 6-inch 50-caliber gun, and it is safe to say that as they stand on paper the results are generally equal, if not superior, to those obtained in foreign navies. The 14-pounder, 3-inch gun will form a conspicuous feature in the armament of our future ships. While by its rapidity of fire it will be suited, like the 6-pounder which it displaces, to repelling torpedo-boat attack, its power and range will render it very effective against the unarmored and lightly armored portions of an enemy's ship. The 4-inch gun

The accompanying diagram shows four patterns, from the 30-caliber, 4·8-ton brown powder gun, as originally carried by our earlier ships, to the new 50-caliber smokeless-powder weapon, which is to be mounted on the "New Jersey." The earlier gun of 1883 was 16 feet 3 inches long and fired a 100-pound projectile with a muzzle velocity of 2,000 feet per second and a muzzle energy of 2,773 foot-tons. Following this came the 35-caliber 5·2-ton gun, which was 18 feet 8 inches long, and gave a muzzle velocity of 2,080 foot-seconds and a muzzle energy of 2,990 foot-tons. This is the gun originally mounted on the "Oregon" and class, but since replaced by the 40-caliber, rapid-fire gun, which is 21 feet 3 inches long, and has a muzzle velocity of 2,150 foot-seconds, and a muzzle energy of 3,204 foot-tons if fired with brown powder. The 50-caliber gun is 25 feet long, and when using the new smokeless powder it will develop a muzzle velocity of 2,900 foot-seconds and a muzzle energy of 5,838 foot-tons, which is more than double that of the earlier, 30-caliber 6-inch brown powder guns of the "Boston" and "Atlanta."

A study of the diagrams shows that the construction of our guns has been greatly simplified by the reduction of the total number of parts of which they are composed. The 30-caliber gun consisted of twelve separate pieces, whereas the new 50-caliber piece, although weighing nearly twice as much, contains only half that number. The difference is due chiefly to the improvements which have taken place in the manufacture of gun steel, assisted by the experience which has been gained in the assembling of built-up guns. The Ordnance Bureau of the navy has always claimed that it could build as efficient a gun on the built-up or hooped system as could be secured under the wire-wound system, which finds great favor in the British navy, and the behavior of our guns, coupled with the high ballistic results achieved with the latest gun, proves that their confidence was not misplaced.

NAVAL GUNS (MODEL OF 1899). — PERFORATION OF FACE-HARDENED ARMOR WITH SMOKELESS POWDER AND UNCAPPED* PROJECTILES.

Caliber.	Length in Calibers.	Weight in Tons.	Projectile in Pounds.	Muzzle Velocity Foot-Seconds.	Muzzle Energy Foot-Tons.	Perforation at Muzzle. Harveyed Nickel-Steel in Inches.	Perforation at Muzzle. Krupp Armor in Inches.	Remaining Velocity at 3,000 Yards Foot-Seconds	Perforation at 3,000 Yards of Harvey Armor in Inches.	Perforation at 3,000 Yards Krupp Armor in Inches.
3-inch.....	50	0·87	14	3,000	874	4·19	3 35	1,401	1·52	1·22
4-inch.....	50	2 56	32	3,000	1,999	6·.2	4·90	1,690	2·85	2·28
5-inch.....	50	4·46	60	2,900	3,503	7·51	6·01	1,771	3·89	3·11
6-inch.....	50	8 0	100	2,900	5,838	9·35	7·71	1,893	5·30	4·24
7-inch†... ..	....		..	....	....	....	....	....	....	. ..
8-inch.....	45	18·0	250	2,800	13,602	13·57	10·66	2,068	9·06	6·61
10-inch.....	40	33·4	500	2,800	27,204	18 57	14·86	2,209	13·53	10 82
12-inch.....	40	52 0	850	2,800	46,246	23 42	18 74	2,291	17·92	14·34

* With capped projectiles an increased thickness of from 15 to 20 per cent can be perforated. † Design not yet completed.

will be mounted on our gunboats, while the 5-inch and 6-inch guns (chiefly the latter) will be used in the secondary batteries of our warships and cruisers. The 8-inch, and possibly the 10-inch, will be used for the main battery of our cruisers, and the 12-inch weapon will be the main fighting element of our battleships, although, if we follow the latest trend abroad, we may discard the 12-inch in favor of the 10-inch gun. The 12-inch gun is the most powerful weapon of its caliber afloat to-day, its muzzle energy of 46,246 foot-tons being only surpassed by the 16 and 17-inch Armstrong guns of the British and Italian navies, which have a muzzle energy of 54,000 and 55,000 foot-tons. The penetration of our gun, however, is considerably greater.

The accompanying diagrams represent proposed alternative designs for arming the 13,500-ton battleships of the "New Jersey" class, the guns to be of the new 1899 model. They were drawn up by the Bureau of Ordnance, and the amount of weight apportioned to armament is based upon the design of the "Maine," in which the weight of armament and ⅔ ammunition was 1,100 tons, or 8·8 per cent of the trial displacement of 12,500 tons. Design 1 calls for the superposed turret, and is really an improved "Kearsarge," the improvements consisting of 2 knots more speed, a lofty spar deck, and the substitution of eight 6-inch, twelve 3-inch guns and twelve 3-pounders for fifteen 5-inch and twenty 6-pounders—a great increase in fighting qualities, especially if the up-to-date character of the guns is borne in mind. Design 2 calls for a new gun, the 7-inch, which does not appear in the list of new guns, as it is yet under consideration and its details are not yet determined. It will have vastly greater power and about equal rapidity of fire to the 6-inch gun, being effective against armor at ranges where the latter weapon would be useless. The eight 7-inch guns would be carried in superposed casemates at the four corners of the secondary battery, with the eight 6-inch guns mounted amidships between them. Half of these guns would be located on the main deck and half on the spar deck above. The arrangement looks well upon paper and should prove very satisfactory in practice, as the weights would be well distributed and it would be possible to concentrate two 12-inch and four 7-inch guns dead ahead or dead astern.

Design 3 is inferior in weight of armament, with two 7-inch guns omitted, and the concentration ahead or astern reduced to two 12-inch and two 7-inch.

Design 1 is the most powerful, and if the gunnery trials of the "Kearsarge" are satisfactory, it is likely to be adopted. Should it be decided to abandon the use of superposed turrets, a fine compromise could be effected by adopting design 2 with the 7-inch gun replaced by the 8-inch. The all-round fire would be the same as in design 1, and the objectionable features of the superposed turrets would be avoided.

An excellent feature in these ships is the recessed gun-ports of the secondary battery, which allow the long 50-caliber guns to be swung round, muzzle to muzzle, against the ship's side, when they are not in use. This is particularly desirable when the vessels are in harbor, or moored at a dock, the long projecting chase of a modern rifle being liable to injury from passing vessels or from cranes or other obstructions at a dockyard.

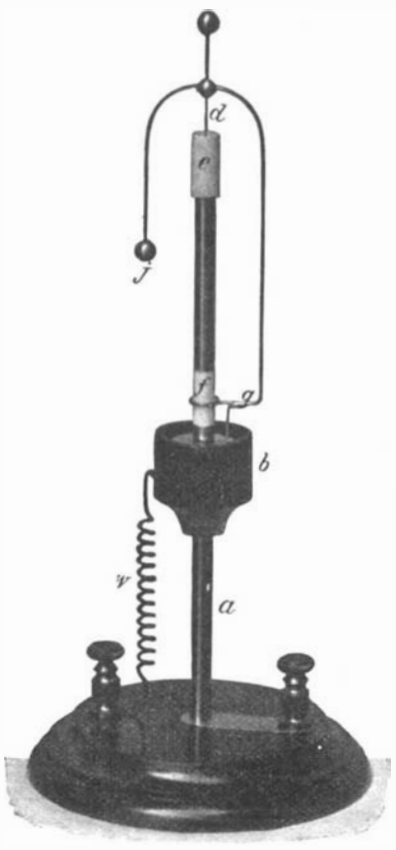
For a further discussion and fuller data respecting the new smokeless powder guns, reference is made to an article on the subject which will appear in the next issue of the SUPPLEMENT.

ELECTRO-MAGNETIC ROTATION.

BY HOWARD B. DAILEY.

In 1821, even before Faraday's discovery of the induction of electric currents in conductors by their movement across the lines of force of a magnetic field, this illustrious savant had shown that the reverse process was possible. Just as a wire forming part of a closed circuit has a current generated in it when forced through a magnetic field, so when a current is made to pass along a conductor placed in such a field the conductor tends to move across these lines of magnetic force. The immense importance of this discovery is recognized in the contemplation of the enormous development of electrical power transmission of to-day. The teacher or student of physics who would demonstrate this principle in a clear and attractive way will find the easily constructed little instrument here illustrated of great value.

A permanent magnet, *a*, of quarter-inch round steel, eight or nine inches high, mounted vertically upon a suitable base, has fixed about midway between its poles a turned wooden cup, *b*, through whose bottom the rod passes. The cup contains a small quantity of mercury which is prevented from touching the magnet by a thick coating of shellac varnish which covers



ELECTRO-MAGNETIC ROTATOR.

that part of the steel surrounded by the mercury. A light brass wire frame, *c*, of the shape shown in the illustration, has soldered to its upper part a sharp pivot, *d*, made of a piece of steel needle which, projecting downward, rests in an indentation made to receive it in the top of the magnet. A short paper sleeve, *e*, fitted around the upper end of the rod and extending a short distance above it, furnishes a small recess into which a drop of mercury is placed to insure good electrical contact at this point. To steady the frame at its lower extremity the wire is bent into a loosely fitting eye encircling the magnet, from which it is here insulated by a thin paper wrapping, *f*. The small weight, *j*, serves to balance the frame and prevent undue friction at *f*. A short piece of wire bent at right and soldered to the frame at *g*, extends downward into the quicksilver,* which is electrically connected with one of the binding posts on the base by the wire, *w*, passing through the side of *b*. The other binding post is connected as shown with the lower end of the magnet. If a current from a battery be passed through the instrument, its course will be as indicated by the arrows, and the frame will rapidly revolve about the magnetic pole in a direction depending upon that of the current, thus illustrating in a simple and beautiful manner the vital principle of the modern electric motor.

THERE is a growing demand in Japan for female clerks, as for example by the Nippon Railway Company, and a special commercial education to fit them for their work is being agitated.

* The lower end of this wire, which is filed to a point and amalgamated, should only just reach the surface of the mercury, which will rise to meet it in a small cone, offering a minimum of mechanical resistance to the motion of the frame. The amalgamation is effected by wetting the point in bichromate battery solution and rubbing with quicksilver.

A New Insect Pest.

It ought to be timely now to note the result of the ravages of the new pest, Agrilus anxius, the borer that about two years ago attacked the ornamental white birch trees in the parks and private grounds of Buffalo, N. Y., and I do this not only as a matter of record, but to point out the degree of success and failure that attended the investigation of the case, though more especially to show what should have been done, and let our failure be a warning to other localities which are pretty sure to be visited by it later on.

Two or three years ago our resident entomologist, Mr. M. F. Adams, discovered that the white birches throughout the city were the subject of some sort of disorder, and on making a general examination, found that a great part of them were victims of a borer at that time practically unknown to science. Later on it was found that it had been described, but so obscure was its history that it had to be studied as new, although another member of the genus, A. rubicollis, which attacks the raspberry canes, was quite well known.

Mr. Adams at once sounded the alarm. He found no way of driving existing borers out of the trees, for though they work in the new wood just under the bark and seldom go to the heart of even small trees, they were well intrenched and so active that they fairly honeycombed the tree in a season, eating away about half of the surface wood and effectually girdling it. It was found that woodpeckers did not attack it, a fact that is hard to explain, for no borer was ever easier of access, and it was also found that there were no casts or other external evidence of their presence, which might give direction to a human warfare on them. The thing to do was clearly to destroy all trees infested by them, and as the white birch is a small tree, especially where planted for ornament, it would have been an easy task.

Still nothing was done. The city park authorities, when asked to stamp out the pest, discussed the matter and waited. Specimens of the limbs or trunks of the trees, fairly tunneled out just beneath the bark, were taken to the park office, but it was thought too bad to sacrifice the trees. The result is that nine-tenths of the city white birches are either dead or dying and the rest will soon follow. Several hundred have died, including about 50 in Forest Lawn Cemetery the present season. Even the dead trees were not burned, and the pests were allowed to multiply at will.

In its larval state Agrilus anxius is a thickish, brown-headed white borer about an inch long. With us it completes the circle of forms in a single year, instead of remaining in larval form a series of years, as is the habit of certain species of better-known borers. It is doubtful if any effective warfare can be waged against it without sacrificing the tree. Some effort to capture the moth by smearing the trees with a sticky substance was made, but this requires too much work. There is already an active parasite in the field, a fly not so very much unlike the ichneumons, lately described as Phasogonfora sulcata, and others, thought to have been described, but not yet fully identified, are making their appearance.

The speedy destruction of our trees should be taken as a warning by other localities to which the borer will migrate very soon without doubt. The lack of notice from observers to the west of us made it possible for the borer to descend upon us unannounced. It has since been found that it visited Detroit before coming here, where it does not appear to have made enough of a stir to attract outside attention. Possibly the white birch is not a very common ornamental tree there. Where the borer stopped on its way here will never be known; probably, had the route been known it would have been possible to save most and perhaps all of the Buffalo birches, especially if the public mind has been at all alert on such subjects, which, unfortunately, is not the case.

Buffalo has a young forestry association that has developed some vigor and may exert a needed influence on the inert public mind, a sample of which I will give in passing. Last spring, when the association was spraying the street trees of a member, to kill the canker worm, an offer was made to treat, free of charge, the trees of a neighbor next door, as they were badly infested, and of course a menace to the neighborhood; but the offer was rejected, and the men and apparatus were ordered off the premises. Speaking of the canker worm (Orgyia leucostigma), it should be remarked that it can be destroyed easily by removing the egg masses from the bodies of the trees, where they are laid by the wingless female. The worm should not be destroyed in the pupa state, as this destroys its parasite also. Observations made in Buffalo find that from 85 to 90 per cent of these worms are killed by parasites while in the pupa form.

Probably the Agrilus will return to obscurity by the same means, but so long as it remains active all trees infested with it should be cut down and burned while the larva is at work. Mr. Adams reports a thicket of yellow birches on the outside of the city attacked by it, and it may be that it is to spread to all species of the birch family.

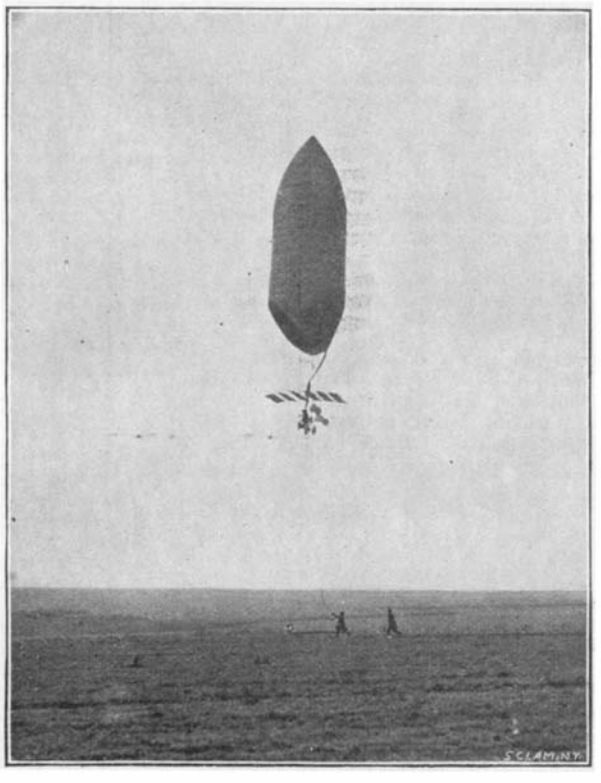
JOHN CHAMBERLIN.

THE DANILEWSKY FLYING MACHINE.

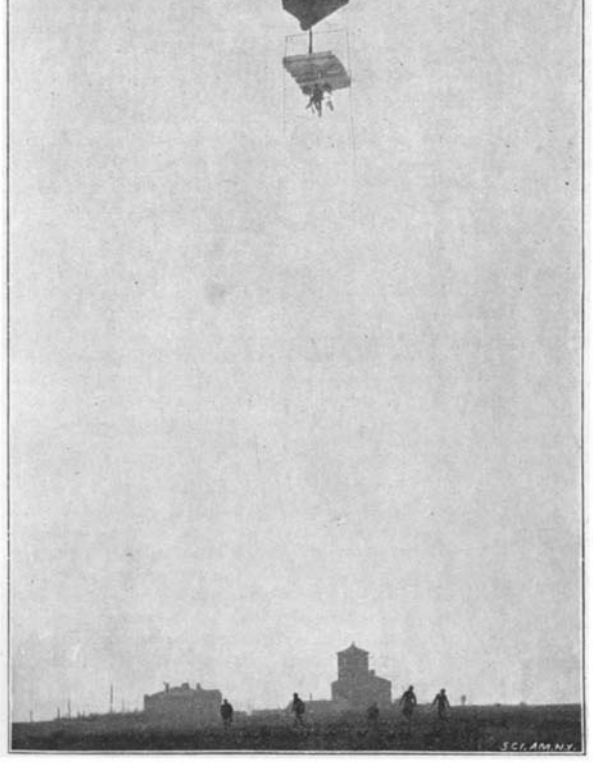
We have been favored by Dr. K. Danilewsky, of Charkov, Russia, with some interesting photographs and particulars of the latest improvements which he has made in his balloon-flying machine. In the SCIENTIFIC AMERICAN for December 31, 1898, we have already illustrated Prof. Danilewsky's first experiments. He is a well-known engineer and an expert in aeronautics, and experiments were conducted under the auspices of the Russian government in order to give the inventor a chance of demonstrating the practicability of this dirigible air-ship, and its feasibility for use in the Signal Service Corps of the Russian army. The results obtained were remarkably successful and were conducted by Dr. Danilewsky himself, who, mounted on his balloon chair, steered the flying machine in any direction he desired. This balloon-flying machine is based on the hypothesis that if a man's strength, in proportion to his weight, is not sufficient to raise him in the air, he can raise himself if of his weight is subtracted. By the use of a balloon partfilled with pure hydrogen the weight of the man is eliminated from the problem, and he can devote all his efforts to propelling and steering the balloon which is supporting him.

When not in use Dr. Danilewsky's balloon is kept in a large shed on his estate. It requires only three or four men to assist in making the start, which is a great advantage over the ordinary military balloon, which requires the service of fifteen men or more to launch it successfully. The Danilewsky balloon has the added advantage of being inflated in a short time, only half an hour being required, and when inflated it can be transported to any distance by the aid of a couple of men. In the trials to which we have referred, the balloon ascended to an altitude of 300 feet and after circling around was brought to a full stop. The descent was then made to the ground in order that the Russian officers could observe its action and see what absolute control of it the inventor had. This is the most important matter connected with any former balloon. It is easy enough to make a balloon or air-ship which will ascend, but the descent is always a hazardous undertaking, and many aeronauts have lost their lives, or at least wrecked their machines, in their attempt. The balloon was then allowed to again ascend until it was completely lost to view. It seemed unaffected by the air currents and went straight up without the slightest deviation. About two hours after it had disappeared a black speck was seen, and at first the officers could hardly believe that it was the returning air-ship. The balloon gradually increased in size, and in the course of a quarter of an hour this peculiar air-ship could be distinguished, and in half an hour the trappings and inventor himself could be discerned. The balloon came down in nearly a straight line, and when about 500 feet above the earth, the speed was slackened, the adjustments were changed so that the direction was slightly altered in order to avoid a large clump of trees on the estate of the inventor. The balloon air-ship passed the trees safely, passing only a few feet over their tops. It then descended very near the great shed, and the inventor leaped out of the chair. It is little wonder that the Russian officers should have been delighted with the remarkable success of the invention.

There is little question that the Danilewsky balloon has many points of value over similar machines. In the first place it only requires the services of a small number of men, the filling of the balloon requires far less time than the ordinary military balloon, and it requires much less space when taken to pieces. Unlike a captive balloon, it is free and can rise to any height desired, passing over the enemy at an altitude too great for them to reach the balloon by means of special balloon guns, such as those made by the Krupps, of Essen, and used with success in the Franco-Prussian war. The absolute control of descent is also a most valuable feature, as it is accomplished without the slightest risk. The balloon shown in our engravings has improvements over the one which we have formerly illustrated in the SCIENTIFIC AMERICAN, and these improvements have added much to its mobility and ease of control. The experiments have induced a number of Russian experts to state that in their opinion Dr. Danilewsky has presented a practical solution of the problem of aerial navigation.



The Ascent.



Nearing the Earth.

THE DANILEWSKY DIRIGIBLE BALLOON-AIRSHIP.

The Situation of Ophir.

A correspondent of Reuter's agency recently had an interview with Dr. Carl Peters on the subject of the rediscovery and identification of the ancient gold-bearing site known as Ophir. According to the German traveler, this much discussed locality is situated on or near the Zambesi River, and he considers that the theories which would place Ophir either in India or Arabia are both wrong.

He does not disprove the early theories, and that which would place Ophir in India, on the banks of the Indus, has much in its favor. The apes and peacocks which were brought to Solomon from the neighborhood of Ophir would seem to indicate that its site was nearer Palestine than India, for it is well known that peacocks would not survive a long voyage, which must have lasted several months and have been made in an open boat. It is hard to avoid the conclusion that more than one place bore the name of Ophir. It is not necessary for the Ophir whence Solomon obtained gold to have been situated as near as the northern end of the Red Sea, for it is most likely that seamen who traded through Hiram obtained goods which they had to sell from the larger boats which sailed through Bâb-el-Mandeb, either to India or to ports on the northeastern and eastern coasts of Africa. Dr. Peters' claim that the discovery of Ophir mentioned in the Bible has been made has awakened considerable interest, and it is hoped that he will lose no time in bringing together the important facts he must have collected in substantiation of this view, including the evidence which would connect the phallic rites and worship of the northern Semites with the nature worshipers on the eastern coast of Africa.

View from Underneath.

Artificial Silk.

For the manufacture of artificial silk a pressure of forty to forty-five atmospheres is required to force the collodion from the reservoirs to the spinning machines, which are constructed with pipes running on each side. Into these pipes are screwed a number of taps with a glass capillary tube fixed on the end, called a silk-worm, through which the collodion is forced; immediately it comes into contact with the air it solidifies, enabling the operative to take hold of the thread or silk, as it can now be called, and convey it to the bobbin. From twelve to twenty-four of these threads are run together on to one bobbin, according to the size of silk required, as is the case with natural silk. After the silk has been dried it is very inflammable and quite unfit for use in textile goods; therefore, a process called denitration is next carried out, which reconverts the product into cellulose. One of the uses of the material is for mantles for the incandescent gas light, it being found that the salts of the rare metals can be mixed with the collodion with greater economy than with any other thread. Large works are in operation at Besançon, in France, producing 7,000 pounds weight per week; but the demand is so great that extensions of the works are being made in order to enable them next January to produce 2,000 pounds per day. The production at Sprietenbach is 600 pounds daily. Other factories are about to be established in Belgium and Germany.—Nature.

WHEN Jumbo, the great elephant who delighted the children of two continents, was killed in Canada in 1885, the skin and bones of the big elephant were saved, and butchers were employed fifteen hours in cutting the flesh from the bones. In the stomach of the great elephant was an assortment of odds and ends including a peck of stones and a collection of coins, which showed that he had been a traveler. There were French, German, Austrian, English and American coins, of all denominations. He also seemed to have a taste for lead car seals, which he had added to his collection on his railway trips. A policeman's whistle was, according to The Inter-Ocean, even found in the capacious paunch.

The Current Supplement.

The current SUPPLEMENT, No. 1255, has many articles of unusual interest. The first page is occupied by engravings showing English armored trains in action in South Africa. "The Homemade Windmills of Nebraska," by E. H. Barbour, is continued, and the present installment describes the Merry-go-round mills, the Battle-ax and Turbine mills. These homemade windmills are attracting great attention, and the subject is a most interesting and important one. The article is profusely illustrated by engravings. "The Catalytic Process for the Manufacture of Sulphuric Acid" is an article by Frederick H. McGahie and describes a most important process which is working a revolution in the manufacture abroad of sulphuric acid. "Armored Turrets" describes four methods of installing and working this important adjunct to coast defense. "The Mors Carriage" describes an automobile, giving a view showing the machinery. "The Canker Worm" is by the late Grant Allen and is accompanied by 19 illustrations.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

DRAFT-EQUALIZER. — JOHN RUSK, Cheneyville, Ill. A U-shaped frame is adapted to be attached to the gang-plow; and on each longitudinal member of the frame an equalizing-lever is fulcrumed. A sheave is mounted on the transverse member of the frame; and a flexible connection between the ends of the levers passes over the sheave. The equalizer, since it is made in sections, can be very closely hitched and prevents all undue side draft when in use on gang-plows for three or more horses.

HARROW. — WILLIAM M. BAKER, Fortville, Ind. The invention is an improvement on a harrow patented by the same inventor, the improvement enabling the machine to be adapted for work in trashy ground. The inventor employs rollers, the teeth of which are intercurrent with the hooked forward ends of rigid blades. These blades are to be substituted for a plain roller when the harrow is to be used in trashy ground; and their action is such that, as the toothed rollers revolve, the hook-ends of the blades catch the refuse material and deliver it at the rear of the harrow, and also pulverize the earth taken up by the roller-teeth.

COMBINED HARVESTER, THRESHER, AND BAGGER.—THOMAS P. MORAN, Nelson, British Columbia, Canada. The invention provides a combined header, thresher, and bagger which will work as well on hilly as on level ground. The header is placed in front and the thresher behind the header, with its long axis at right angles to the line of draft, so that the thresher moves practically side-wise. Behind the thresher comes the team, while the driver's seat and bagging devices are run out to a point in the rear of the team. Special provision is made for leveling and adjusting the various parts of the machine. The team being placed in the rear is thrown away from the standing grain (instead of into it) in steering the front of the machine at a slight angle uphill in counteracting the drift or natural tendency of the machine to slide downhill.

Bicycle-Appliances.

BRAKE.—JOHN F. MOEN, Brooklyn, New York city. The brake comprises a plate or shoe from which a shank extends forwardly, adapted to engage with the crown portion of the front fork of the bicycle. A band, elastic in the direction of its length, detachably secures the brake to the fork. The brake can be applied to a bicycle without the use of clamps or screws.

Electrical Apparatus.

CABLE-TERMINAL.—WILLIAM CALLAHAN, Sidney, Ohio. The cable-terminal is to be used in making connections with aerial telephone-wires where it is necessary to place the wires on a pole or at any other place where a cable terminates. A neat and convenient means is furnished for making connections, with provision for receiving and conducting away the accidental heavy charges due to lightning or the crossing of the lines with high-tension electric-light wires. Moisture is prevented from creeping into the strands of the cable at its terminal.

Mechanical Devices.

AUTOMATIC ADJUSTABLE DIE. — FRANK H. STAHL, Charlestown, W. Va. The invention provides several die-blades so supported that they may be adjusted to proper relation to cut the thread upon the end of a pipe-section. When the thread has been cut on a lathe, the blades can be automatically released and spread apart so the die can be quickly moved back for another operation, thereby effecting a very considerable saving in time. The die can be adjusted to different sizes of rods or pipes as well as to take up wear on the cutting surfaces of the blades. Thus the device combines a number of dies in one, whereby its usefulness is increased. By reason of the automatic release, the die can not run too far and jam against a shoulder, as so frequently happens in the ordinary construction.

Miscellaneous Inventions.

DISTANCE-FINDER. — ROBERT L. MARSHALL, Elizabethtown, Ky. The purpose of the invention is to provide a practical and accurate instrument for finding the distance or range of any remote object by a simple adjustment, without any calculation whatever. The finder has a base-line at right angles to which is a stationary telescope jointed to a movable hypotenuse-bar provided with a second telescope. The hypotenuse-bar has a laterally-adjusting device with a variable throw or range of deflection. Mechanism between an index-hand and the hypotenuse-bar also has a variable throw or range of movement, the variable throw of one of these parts being reverse to that of the other in respect to the relation of speed and power, so that the dial of the index-hand can be spaced off with equal graduations, a feature of great importance in securing accurate results.

PLOTTING INSTRUMENT.—LUTHER M. CARMICAL, Jonesville, Va. This plotting instrument comprises an arm and a base-plate, provided with different graduations on each edge. A guide-bar is fixed on the base-plate; and at right angles to the guide-bar is the base-bar of a protractor. A sleeve adapted to slide on the guide-bar, is rigidly attached, and has a flange serving as an index for the adjacent graduated edge. The sleeve has a clamping-section by means of which the protractor may be held in any adjustment. The instrument is used in drafting in poles or feet the field-notes of a survey as usually obtained by compass and chain, and ascertaining the area therefrom.

ACETYLENE-GAS APPARATUS.—ALPHONSE F. GAIENNIE, Thibodeaux, La. The acetylene apparatus comprises a generating-tank, into which a carbid-hopper has a gravity-discharge. A valve controls the discharge-opening, the stem of the valve extending vertically through and above the carbid-holder and being joined with a lever connected with the gasometer-bell. As the gasometer-bell falls, the lever is caused to open the valve in order that carbid may drop into the generating-tank; as the bell rises, the valve is closed.

TAPE-NEEDLE.—WALTER S. HUTSON, Pocatello, Idaho. By means of this tape-needle, a string can be quickly passed through hams, shoulders, and other meat. The pointed head of a shank terminates in shoulders at its inner ends. A locking-arm is pivoted on the shank and comprises two connected side members respectively lying on the sides of the shank. The locking-arm has its front end arranged to engage the shoulders of the shank-head to limit the movement of the locking-arm. The front end of the locking-arm is formed with a recess to receive a thread, the recess being closed at the head of the shank when the locking-arm is engaged therewith. A spring serves to throw the locking-arm into closed position.

ACETYLENE-GAS GENERATOR. — OLIVER H. HAMPTON, Williamsburg, Ind. The apparatus is arranged to generate gas in proportion to the amount needed and consumed by the burners, to withdraw the carbid-ashes with the carbid-holder upon removing the latter for recharging, and in case of excess pressure of gas to prevent the water from being forced out of the generator-tank. The generator comprises a carbid-casing, a gasometer having a tank and bell, a gas-conducting pipe leading from the carbid-casing to the gasometer, and a valve on the pipe within the gasometer and normally held to its seat by a spring. A weight is loosely carried by the gasometer-bell and is adapted to move the valve into an open position against the tension of its spring upon the descent of the bell.

LAMP-BURNER.—HARTWELL A. CROSBY, Calais, Me. The invention comprises a wick-tube and a wick-elevating device. The wick-elevating device consists of a toothed wheel outside of the wick-tube and adapted to engage the wick. A frame is pivoted upon the wick-tube and has an extinguishing member adapted to swing over and cover the tube. A triangular bar is journaled in the lower end of the frame and is engaged by the toothed wheel, so that the frame is swung and the end of the wick-tube is uncovered when the wheel is turned in one direction; and the wheel is prevented from turning in the opposite direction as soon as the frame is permitted to swing back by the dropping of the wick.

UMBILICAL FORCEPS.—ERNEST V. ACHESON, Salt Lake City, Utah. The forceps are so constructed that the umbilical cord may be cut in two at one operation of the instrument. The ends of the cord will be automatically fastened or sealed by the instant application of insulated aluminium, gold, silver, or wire bands. The instrument is so constructed that the various parts can be readily separated for the purpose of cleaning or sterilizing and as readily assembled and adjusted.

COOKING-UTENSIL.—WILLIAM A. VAN DEUSEN, Brooklyn, New York city. The cooking-utensil consists of a number of vessels capable of use either singly or collectively and employing but a single cover. The utensil is particularly adapted for steaming cereals, vegetables, custards, and puddings, and is so constructed that the steam will have access to the sides of the vessel in which the food is placed, from top to bottom, insuring a rapid and uniform cooking.

OIL-PRESS MAT.—ROBERT F. WERK, New Orleans, La. This new oil-press cloth consists of a fabric composed of long hair. The hairs forming the warp threads of the fabric are hard, stiff, or coarse, and have a hard twist. The hairs for the weft-threads are soft and pliable and have a soft twist. The mat is designed for use in cotton-seed and other presses, and is not liable to lose its shape when subjected to heavy pressure, or to adhere to the meal-cake.

BLACKBOARD-SUPPORT.—JAMES S. MCCLUNG, Pueblo, Colo. The support is so constructed that a teacher can face his class and at the same time write on the board while it is in a horizontal position, turn the board so that the pupils can see the work right side up and quickly remove the work from the pupils' sight. The arrangement is especially adapted to train children to see quickly and accurately.

CARBURETER. — ELIJAH D. PARROTT, Portland, Ore. The object of the invention is to provide a carbureter arranged to prevent frost from forming on the inside of the evaporating-coil or in the gas-mains leading from the apparatus. The apparatus is provided with a water-tank and with an evaporating-pan connected with a gasoline-supply and an air-supply. An evaporating-coil leads from the pan, the pan and the coil being submerged in the tank-water. A heater is connected with the water-tank to heat the water; and a pump is connected with the coil.

ACETYLENE-GAS APPARATUS.—LEWIS J. RUTH, Leamington, Canada. The invention belongs to a class of acetylene apparatus in which the generator and gasometer are separated and the carbid is placed within a perforated or grated cylinder which may be revolved, the water being supplied by a perforated pipe or spray over the cylinder. The lime formed by the decomposition of the calcium carbid will be sifted out of the carbid by the rotary movement given to the cylinder when the gasometer-bell rises. This lime falls upon the inclined bottom of the generator and is then removed. When the gasometer falls, water is admitted to the perforated pipe and sprayed on the carbid. The gas generated will cause the gasometer-bell to rise and the water is cut off.

ARTIFICIAL TOOTH-CROWN.—CHARLES A. FONES, Manhattan, New York city. The device comprises three parts—the crown, a connecting-sleeve, and a locking member or lock-screw. The construction allows the parts to be accurately adjusted and forms an artificial tooth-crown of exceptional strength. No longitudinal strain can separate the crown from the sleeve or from the lock-screw. Since no platinum is required, the device is comparatively cheap.

PROCESS OF FORMING CONCRETE WALLS.—CHARLES GUY, Box 242, Topeka, Kans. This cheap process of forming a concrete wall consists in erecting a crib having a face corresponding with the desired form of the concrete surface to be produced; next applying a thin layer of plaster upon the face; then laying a coarse or open-grained fabric upon the stratum of plaster; applying concrete in contact with the fabric and allowing it to set; and finally removing the crib and stripping the fabric with the adhering plaster from the concrete surface. No surfacing or matching of lumber is necessary.

Designs.

WALL-PAPER.—HARRY WEARNE, Rixheim, Germany. The leading feature of the design is a lattice scroll having reverse curves located between borders of irregular outline made up of conventionalized flowers and leaves. Bouquets of flowers, leaves, and buds are located at the convexed portions of the scroll.

BUSTLE AND HIP-FORM.—FRANCIS B. GRANGER, Manhattan, New York city. The bustle and hip-form comprises a crescent-shaped body portion within which is arranged a pad-like portion of a contour substantially that of the body portion, but having its edges spaced from the edges of the body portion.

TEAPOT. — AUSTIN F. JACKSON, Taunton, Mass. The teapot is decorated with raised ornamental work applied on the cover and neck in the form of a foliated, flowered spray.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS ETC.

MAGNETISM AND ELECTRICITY. An Elementary Treatise for Junior Students, Descriptive and Experimental. By J. Paley Torke. London: Edwin Arnold. 1899. 16mo. Pp. 264. Price $1.40.

The author notes clearly the fundamental facts and laws of magnetism and electricity. The explanations are lucid, and the illustrations have a freshness not usually seen in text books. It will probably be largely adopted in schools.

NATURE STUDY FOR GRAMMAR GRADES. A Manual for Teachers and Pupils Below the High School in the Study of Nature. By Wilbur S. Jackman, A.B. New York: The Macmillan Company. 1899. 12mo. Pp. 407. Price $1.

Nature study is one of the most interesting developments of modern education, and the volume before us is admirably adapted to assist teachers in preparing experiments and questions. That pupils need some rational and definite direction in nature studies is now agreed, but to prepare outlines in suggested directions necessary so as to place them within the reach of each pupil is more than the ordinary teacher has time to do, but the volume before us has admirably filled this gap in the literature of the subject. Such subjects as botany, mineralogy, astronomy, natural philosophy, etc., are taken up.

ELECTRIC POWER TRANSMISSION. By Louis Bell, Ph.D. New York: Electrical World and Engineer, Inc. 1899. 8vo. Pp. 505. Price $2.50.

A thoroughly practical treatise for practical men and is adequately illustrated. It is the best book on the subject we have seen and fills a field which has not been adequately covered before. Modern electrical practice moves so quickly that treatises on the subject are rapidly rendered useless, and for this reason an up-to-date book has been needed.

INDUCTIVE GEOMETRY. By Col. C. W. Fowler. Published by the author at Louisville, Ky. 1899. 18mo. Pp. 55.

THE SUCCESSFUL MAN OF BUSINESS. By Benjamin Wood. New York: Brentano. 1899. 16mo. Pp. 208.

There can never be too many books of the present nature, dealing with success in business life, though in the majority of cases it will be found that those who have actually achieved success do not write books of this kind, but the author's intention is undoubtedly good, and they are worthy of considerable circulation. It is true that business men frequently write books, but they are nearly always upon some subject far removed from their immediate source of livelihood. The author deals with the subject from an eminently practical standpoint.

A DIVIDEND TO LABOR. A Study of Employers' Welfare Institutions. By Nicholas Paine Gilman. Boston: Houghton, Mifflin & Company. 1899. 12mo. Pp. 400. Price $1.50.

This volume deals with a subject which in the near future is certainly destined to be one of the most important of economic problems. A thorough understanding of the principles outlined in this book would tend to cause capital and labor to unite on a substantial basis and to prevent those most unfortunate of economic revolutions—strikes. The author discusses the modern employer, welfare institutions in Germany, patronal institutions in France, patronages in Holland and Belgium, profit sharing, etc. It contains abundant food for thought.

AMERICAN SOAPS. A Complete Treatise on the Manufacture of Soaps, with Special Reference to American Conditions and Practice. Dr. Henry Gathman, Editor of the American Soap Journal. New York: Published by the author. 1899. 8vo. Pp. 461. Price $15.

The first edition of "American Soaps" appeared in print seven years ago and was well received, and since that time the author has continually collected all the available new information that could assist in making a later edition of the book more complete, and the author has had the benefit of the experience of many of the original purchasers of the book. There is an extensive literature upon soap making, but most of them are adapted from foreign practice or deal with antiquated methods. The present book cannot be placed in this category. It is an excellent contribution to technical literature by a man who thoroughly understands modern American soap making and it is in no sense a compilation. To those who are looking for a thoroughly practical book on soap making of all kinds, with special reference to modern practice, we can heartily recommend this book. It is freely illustrated, and the number of formulas for soaps of various kinds is large. The section devoted to the actual processes used in the manufacture of soaps of all kinds occupies three-quarters of the volume. It is an admirable book.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7801) P. C. W. asks: Is there any known process by which I can send a current of electricity through a paper in a dry form by having subjected it to a process so it will conduct electricity? A. You cannot send an electric current through a dry paper. There is no substance which will render dry paper a conductor. Only the spark of a high tension discharge will pass through dry paper.

(7802) S H. D. says: Will you tell me the horse power of the ten wheel or mogul railroad engine, also the horse power of the hog and jack, or consolidators? What is meant by the term horse power? Please tell me how to calculate the horse power of any engine. Give the simplest way. A. The horse power of any locomotive can be found by multiplying the area of the piston in square inches by the mean effective steam pressure in the cylinder; multiply the product by 2, which will give the total average pressure on both pistons; multiply this sum by the number of feet the piston travels in 1 revolution of the driving wheel, then multiply this product by the number of revolutions the driving wheel makes per minute, and divide by 33,000. Example: What is the horse power developed by an engine having cylinders 19 inches diameter by 24 inches stroke, having an average cylinder pressure of 53·7 pounds per square inch? The driving wheels being 78 inches diameter and making 260 revolutions per minute (about 60 miles per hour)?

283·5294 square inches piston area.
53·7 pounds mean effective (average) pressure.
15,225·5 pressure on one piston.
2 pistons.
30,450 pressure transmitted from both cylinders.
4 feet piston travel in each revolution.
121,804
260 revolutions per minute.
31,669,040÷33,000=959 horse power.

One horse power is a power that will lift 33,000 pounds one foot high in a minute. The horse power of any engine is computed on the same principle as shown above, considering the multiplier 2 as referring to 2 cylinders, and not used with 1 cylinder.

(7803) B. F. S. asks: 1. Would a field of wrought iron ½×2½ inches square do for a field of motor described in SUPPLEMENT, No. 641? I wish to use it as a generator. A. A field of wrought iron, forged of the same size as that of strap iron, may be used in place of the strap iron. The reason for using the strap iron was to enable those to build the motor who had no means of forging a piece of wrought iron. 2. Would the field be equally serviceable if brazed instead of welded? A. Yes, if the brazing is put exactly opposite the middle of the armature. 3. Compare such a field with a laminate one. A. The brazing is no better than an air space for transmitting the lines of force, and should be placed where the lines of force leave the poles and pass through the armature. 4. In making plunge battery (see SCIENTIFIC AMERICAN SUPPLEMENT, No. 792), the upper ends of the carbon plates are permeated with paraffine. Will this have any effect on the making of electrical connections made by strips of copper, i. e., is paraffine a conductor of electricity? A. Paraffine is not a conductor, and should be scraped off where the contact is made with the copper strips. 5. If you take a bicycle wheel and place one end of the axle on some support such as your finger, it will fall over, but if you first cause it to rotate rapidly it will maintain its perpendicular and pass around its point of support. Please explain. A. The principle involved in this is that of the gyroscope. All rotating bodies tend to remain in the plane of rotation.

(7804) J. L. B. writes: I saw in your paper some weeks ago the statement that you did not know where the energy went to if a watch spring was wound up tight and then burnt. Is it not true that if a piece of wood is bent and ignited it will take less energy to ignite it than if the same piece or at least the same amount of wood was ignited when it was straight? If this is so, is it not possible that it will take less energy to ignite the steel spring, and these might equal each other? I cannot do experiments to prove if this is so and thought I would write and ask you if this is so. A. We do not know whether it is true or not that straight wood burns easier than crooked wood. If it does, it will explain why the crooked stuff we had to work up in boyhood was such poor wood to burn. Till however some one can present careful experimental data showing that a spring under strain evolves more beat in combustion than a loose one, we shall continue of the opinion that the matter has not been proved. It is simply a begging of the question to say that the doctrine of the conservation of energy requires a certain result, and therefore that is the result to be required.

(7805) H. C. M. asks the ton burden of the "Kaiser Wilhelm der Grosse" and the number of passengers it will carry. A. The displacement (that is total weight) is 17,500 tons; it accommodates 350 first-class passengers; 370 second-class; 800 steerage, and the crew, etc., number 450. If you will refer to the SCIENTIFIC AMERICAN for October 9, 1899, you will find your query fully answered. This article gives valuable particulars regarding this vessel.

(7806) G. F. M. asks: Will you kindly answer for the benefit of settling a controversy whether this new year (1900) is the beginning of the 19th or 20th century? A. The new century begins January 1, 1901.

(7807) F. K. H. writes: I am making a horseshoe magnet; the iron is ¾ inch thick and about 7 inches long. Will you please tell me what size wire I shall use, and how much, to make it strong enough to draw small pieces of iron through 1 or 2 inches of wood? Also please state how many cells of battery I should use on same? A. The easiest way to wind the legs of your horseshoe magnet is to make spools which will just slip over each leg. Wind these with No. 12 cotton covered wire, attending very carefully to the insulation and filling the spaces with shellac after each layer is wound. Allow each coat to dry before putting on the next layer of wire. The wire may be wound about an inch deep. The bichromate plunge battery described in SUPPLEMENT, 792, price 10 cents, will fully energize the magnet. If you mean to make a magnet which will draw a piece of iron directly through two inches of wood, so that it will enter on one side and come out of the wood on the other side, making a hole through the wood, you will be disappointed in your work. No magnet can do this. A magnet of good strength will cause small pieces of iron to move at a distance of two inches from its poles. It does not matter whether the space is filled with wood or air.

(7808) H. W. T. asks: 1. I have the castings and parts for the little motor of which I inclose a cut taken from your advertising columns. What size of wire shall I use on fields and armature? A. Almost any size from 18 to 24 will answer to wind the little motor. 2. Will 9 cells of Samson or carbon cylinder battery run a 10-candle, 12-volt lamp not more than 20 minutes a night? A. Yes. 3. Is there any way of recharging dry batteries? A. Dry cells are not recharged. They are not worth the trouble.

(7809) W. P. asks: 1. What causes "cross talk" in a telephone? Can you tell me the remedy for it? A. Cross talk in a telephone is caused by the wire of another grounded circuit, near the wire of the telephone line in which the cross talk is heard. The remedy is found in a metallic return wire twisted around the other wire of its own circuit. See Poole's Practical Telephone Handbook for instructions. Price $1.50 by mail. 2. I have some small machine steel screws in some brass material which I cannot take out with a screw driver (it is a screw which holds the fork of a desk phone). Please tell me how I can take this out. A. Put a few drops of kerosene oil on the screw head and let it stand a few hours. 3. How can I charge the telephone standard Fuller battery? A. A solution for the Fuller cell may be prepared by dissolving 7 ounces of sodium bichromate in 1 quart of water and pouring into the solution very slowly when cold, ⅛ pint of strong sulphuric acid.

(7810) H. C. H. writes: I wish to make a small storage battery capable of running a 3 candle power lamp a given number of hours on one charge. A. We advise you to purchase Salomon's storage battery, price $1.50. This book will give you the instruction needed for making what you need.

(7811) W. J. M. asks: How to tan fur hides and skins so they will remain soft after tanning? A. We refer you to SUPPLEMENT, numbers 959, 1077, 1090 and 1140. Price 10 cents each by mail.

(7812) C. J. asks: Will you please give directions how to wind ringer coils for a telephone? A. There are many varieties of ringers. The resistance of the coils is usually from 75 to 100 ohms, though it is sometimes as high as 5000 ohms, varying according to their use. Wind each of the spools with about 40 ohms of fine silk covered wire, No. 36 or 38, and mount them so that the opposite poles shall be toward the armature.

(7813) E. B. W. asks: Is there such a thing as an electric belt that is good for anything? A. We have never seen an electric belt in which we could put any confidence. If any one is in need of electrical treatment, he should consult his physician, who knows his constitution, and not a stranger at a distance. He will then have the proper form of application for his condition. At the most the electricity from a belt is too feeble to expect any benefit from its use.

(7814) E. B. H. asks: What effect would it have on the length of the spark in an induction coil if No. 30 cotton covered magnet wire were substituted for No. 36? A. To use No. 30 in place of No. 36 wire in the secondary of an induction coil will reduce its power approximately to one-fourth of its value, since there will be but about one-fourth as many turns in the same space.

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Cotton opener grid, F. A. Wilde 641,060
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Curtain rod fixture, J. O. Clark 640,993
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Cutter bar, J. F. Kukacka 641,123
Cutter bar, H. C. Loudermilch 640,783
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Cycle saddle attachment, F. H. Thibault 641,169
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Electrical circuit earthing device, L. J. Steele 641,161
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Elevator, Bartholomew & Leonard 640,859
Elevator, Stoddard & Richards 641,164
Elevator hatch door mechanism, H. C. Richards 641,231
Enameling process, C. H. Waterman 640,844
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(Continued on page 46)

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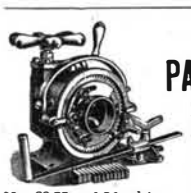

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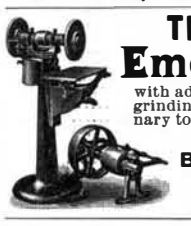

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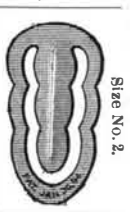

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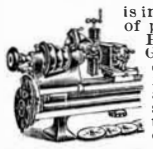

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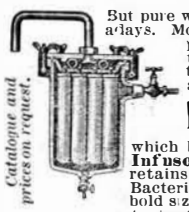

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Rotary engine, W. M. Farrow 641,199
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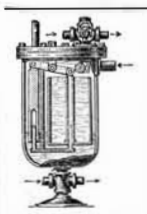

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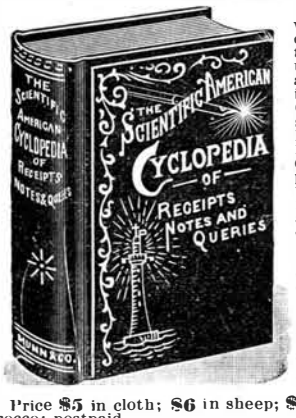

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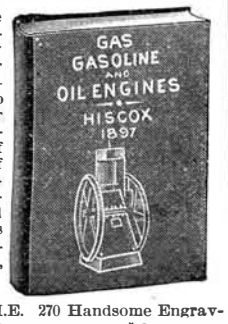

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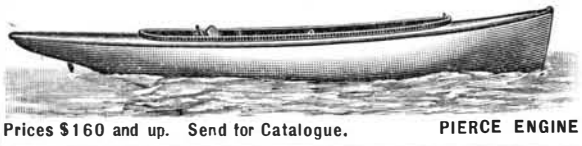

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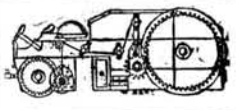

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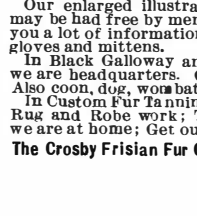

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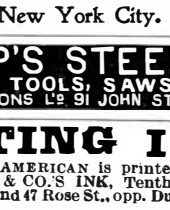

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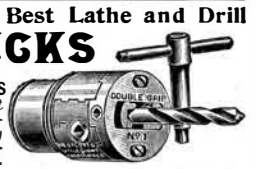

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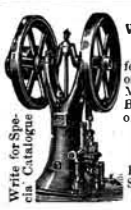

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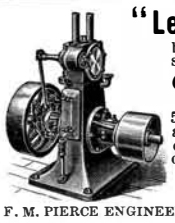

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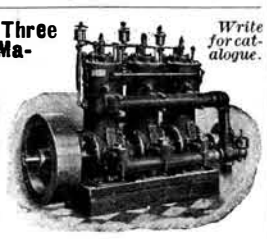

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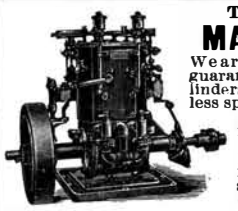

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